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EDITORIAL ANNOUNCEMENTS

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages and all of the advertisement pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Transport and Railroad Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

VOL. XXXVIII. No. 14. FRIDAY, APRIL 7, 1905.

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In appointing a new Isthmian Canal Commission, divided into departments each of which has independent executive powers in its own field, the President is acting in plain belief of the principle that victories are not won under debating societies. The trouble with the old commission was its unwieldiness, arising from a form of organization which was inherently inflexible. A deliberative body, instead of an executive body, had, in effect, been created, and there were evidences that formalism like that of the British Colonial Home offices might be expected to result. Under the new arrangement, the Chairman, the Chief Engineer and the Governor of the Canal Zone are the high-salaried officers, and each has definite and full-powered responsibilities, subject to report to the quarterly meetings, on the Isthmus, of the full Commission. The importance of a consulting board of distinguished engineers is not overlooked, but this board has been so placed that its work will be an adjunct to, rather than a part of the task of the Commission. The President is much to be congratulated on effecting so clean-cut and practical a business organization; an organization which is vested both with the incentive and with the opportunity to work at once rapidly and harmoniously.

The Long Island Railroad has been singularly visited with misfortune in the loss of two chief executive officers, by death, since the beginning of the year. Mr. Baldwin, who died January third, was an admirable man to handle the great problems which confront the company, in its transition stage from an unconnected suburban line, prone to operate unprofitably because of the short business season, into an extension, really, of the rapid transit system of the greatest city in the country. He saw clearly the use and value of Long Island as a residence district for New York, provided only proper communication could be established, and he inspired confidence in others who were willing to provide for this communication, looking to the future for their profits. Mr. Baldwin brought Mr. Potter to New York with him from the Pere Marquette, when he succeeded Austin Corbin as President of the Long Island, and Mr. Potter served as his able lieutenant in the difficult task at hand. Thoroughly conversant with every detail of the work, Mr. Potter was almost perfectly equipped to carry it on, and he accepted the burden with no loss of time in feeling his way. His untimely death, chronicled this week, left no obvious candidate for the position. Samuel Rea has been Acting President during Mr. Potter's illness, but it was evidently decided, in the appointment of Mr. Peters, hitherto General Superintendent of the Southwest System of the Pennsylvania, that Mr. Rea would be unable to spare enough time from his other pressing duties to pilot the Long Island through the lean, thankless years that must intervene prior to the opening of the East river tunnels and the electrification of part of the system. During these next few years, fixed charges will pile up rapidly without compensating increases in earnings, and the President is likely to find himself, *ex officio*, in a position of considerable unpopularity, with the problem of keeping and building up his suburban business while maintaining rigid economies.

LOCOMOTIVE TESTS AT ST. LOUIS.

The first bulletin giving results of the locomotive testing at St. Louis has been issued by the Pennsylvania Railroad Company and a liberal extract of it is printed elsewhere in this issue. Owing to unexpected delays it was not possible to issue separate bulletins at the conclusion of each test, and it has now been decided not to issue any further bulletins. The results of all the tests together with other matter pertaining to the exhibit of the railroad company at St. Louis, will be published in book form in the near future. While the decision to discontinue the publication of bulletins may be the cause of some regret, nevertheless it will now be possible to finish up the entire work in much shorter time than would otherwise be possible if separate bulletins were to be issued. Furthermore, the work is of such a nature that its full value will not be apparent until all the data obtained from each engine is completely analyzed and presented under one cover. Altogether, eight locomotives have been tested. Four of these were freight engines and four were passenger engines. The four passenger locomotives were all of the four-cylinder balanced compound type. When the testing plant has been installed at Altoona, the investigations will be continued, using other types of locomotives.

The bulletin which has just been published gives the results of tests of a Pennsylvania H6a consolidation locomotive. The bulletin contains about 80 pages, including an appendix which gives complete tables of observed and calculated data, graphical running logs, typical indicator and dynamometer diagrams, comparative diagrams and details of the locomotive. The H6a locomotive weighs 194,200 lbs., with 173,200 lbs. on the drivers. The cylinders are 22 in. x 28 in. and the drivers are 56 in. in diameter. The total heating surface, based on the fireside of the tubes, is 2,482 sq. ft., and the grate area is 49.2 sq. ft. Altogether 17 separate tests were made with this engine, although five of these tests were afterwards thrown out. Most of the recorded tests were continued for at least three hours. The locomotive was run at four different speeds, namely, 40, 80, 120 and 160 r.p.m. respectively. At each speed several tests were run at different cut-offs. At all speeds above 40 r.p.m. the maximum power of the locomotive was closely approached, but at 40 r.p.m. it was found impossible to run tests at maximum power owing to the danger of slipping the drivers, and hence wearing flat spots on the supporting wheels.

The maximum power of the boiler, as disclosed by these tests, is represented by 12.39 equivalent pounds of water per square foot of heating surface per hour. When working at that rate, about 890 boiler horse-power is developed and about 4,163 lbs. of coal are burned per hour, while the boiler efficiency is 48.69 per cent. The highest efficiency of the boiler which was obtained was 78.93 per cent., but the boiler was working at a very low rate, the hourly evaporation being but 5.18 equivalent pounds per square foot of heating surface.

The highest indicated horse power was 1,036.1, which was obtained at a speed of 120 r.p.m. and a cut-off of 35 per cent. Under these conditions the steam consumption was 23.74 pounds per indicated horse power per

hour. The lowest recorded steam consumption was 23.43 pounds per hour, the speed being 120 r.p.m. and the cut-off being 31½ per cent. The machine efficiency ranged from 72.9 per cent. to 84.8 per cent., which is a pretty good performance considering that the engine had not been thoroughly broken in before testing.

All the engines which have been tested will be treated according to the plan of Bulletin No. 4. The final book should be an important addition to the technical literature on locomotive design. The Pennsylvania deserves much credit for the thoroughness with which the work has been done and for its unselfish scientific spirit in giving to the world the results of the tests.

THE REPORT ON SIGNAL STANDARDS.

The report of the Signaling Committee of the Maintenance-of-Way Association marks real progress. It is not a thorough or complete report, evidently because of the fashion in that Association to hand in a report every year or two, whether there has or has not been time to fully explore the subject in hand; and the members were subject probably to the limitation that seems nowadays to hamper all committees which do not possess ample funds and unusual courage—inability to meet and confer as fully and frequently as they ought. But the committee is the strongest one that has dealt with this subject in recent years, and the report, as far as it goes, takes firm ground.

The most important recommendations are Numbers 3, 4, 5 and 8 under interlocking, and No. 1 under manual block signaling. With crossovers that may be safely traversed at 50 or 60 miles an hour, which are now common four-track lines, two grades of "high" speed are necessary; and the use of dwarf signals for diverging low-speed routes appears to be so thoroughly satisfactory that general approval of the committee's position may be taken as assured. To have three, four or more high arms on a post is already condemned almost universally by signal engineers, but they do not seem to reform their practice nearly so fast as they do their ideas. The reform requires a change even in a two-arm signal, if the upper is for the slower route, but in this feature some roads are even slower than in getting rid of five-arm signals. Enginemen may continue to run for years successfully under a system which falls short of the highest standards; but the number of enginemen is all the time increasing and the ideal system is needed for the benefit of the new ones as well as for the relief of the old.

It is regrettable that on this matter of ameliorating the duty of the high-speed engineman the committee did not go farther and recommend, instead of merely mentioning, the use of the blue for the night stop indication in dwarf-signals. It will not be easy, probably, to secure agreement as to how completely red lights can be hidden from fast trains, but we believe that a large majority of progressive men will agree to this much. The use of blue ought to be fairly satisfactory to those who believe in blinding the lamp of a minor signal when the arm is horizontal, for blue is almost as poor a light as black! Mr. Rudd, when on the Lackawanna, even blinded high signals for diverging routes, and the practice has proved satisfactory after four years' use. The use of fixed signals is now sufficiently common and generally understood to justify giving increased prominence to the fundamental principle that an engineman shall proceed only after he has seen a proceed signal—that the absence of such a signal is an all-sufficient indication to stop.

The recommendation of two distant signals where there are diverging routes, both high-speed, is excellent, and the argument for it unanswerable. Railroad officers who do without distant signals where fast time is required, justify themselves with various alleged arguments purporting to show that the signal is not necessary; but the real fact is, no doubt, in 99 per cent. of the cases, that in foggy weather, with only home signals, the enginemen do not run under control as the rule requires, but take chances. One of the arguments for not having distant signals—that signal men will not use them, is decidedly discreditable; not, perhaps, to the signal engineer, but to some one whom he ought to influence toward better practice. Recommendation No. 8 is one that everybody ought to agree to without question; but why do we need to break away from the well-settled English nomenclature, "starting-signal?"

The recommendation to put block signals always at the right of the approaching engineman is the committee's way of expressing disapproval of the common practice of having the block signals at small stations (for both directions) on a post in front of the office. This arrangement necessitates loose practice in train movement and, of course, ought to be abolished. On electric locking of manual levers at crossings the report is silent.

The most noticeable defect in the report is its attempt to do for the trainmaster things which he ought to do for himself, as, for example, providing against a collision when a light is accidentally extinguished. Not every signal engineer will agree that this is a defect; and it must be admitted freely that the enterprising signal engineer is pursuing a laudable course when he is trying to provide every safeguard against collision that the mind can devise; but the superintendent should not demand the impossible. Neither can he fairly ask the signal department to use a complicated means to accomplish what could be done by a simple means if dealt with by some other department. One of the first articles of locomotive running is a speed limit. Only on a straight line, with the best track, best engine and cars, with preceding trains out of the way and no dangerous descending grades for a long distance ahead can the engineman run at unlimited speed. Practically, he must habitually have some speed limit in mind, signals or no signals. In other words he must know the road thoroughly. For the signal department to try to provide an easy path for a runner who does not know the road perfectly may easily cause a needless waste. The notion of indicating different degrees of safety, at different places, by semaphore signals, which seems to be cherished by some, would necessitate a variety of shapes and sizes, producing intolerable confusion. To provide indications for three different rates of speed, as is done in the committee's final recommendation is all that the signal engineer should be expected to do. To do even this much, certain conditions must be taken for granted; must be understood as having been provided for by the trainmaster. To say that the highest arm, when cleared, indicates "unrestricted" speed means that the speed is not restricted by the signalman; by some other authority the runner may be subject to a variety of limitations; as, for example, in entering a great terminal like Boston or St. Louis; or while running over a complicated crossing. The rule to use dwarfs for all low-speed movements ought to be (and is) modified in wide yards, for nearly or quite all signals in such yards should be on bridges; though by putting the low speed arms at or below the foot of the post, the principle laid down by the committee can be adhered to.

The committee's discussion of the question of distinguishing automatic from attended signals well illustrates the futility of trying to provide everything in the signals and to leave nothing to be done by the brain of the engineman. If there really is a danger of collision or derailment from the mistake of an engineman in reading one signal because another signal is out of order, and if that danger ought to be provided against by the signal department, distant signals had better be made different from home signals in both of their night indications. This could be done by using for each distant signal two lights, side by side. If this be objected to as increasing the cost, we again reply that the signal department is not bound to meet every kind of difficulty that may arise in train-operation. Another plan would be to put the distant signals always on separate posts. Where they are on a home post they could be set a little in advance. If necessary, what real harm in setting the distant 25 ft. in the rear, on a shorter post? Or even 100 ft.?

For two generations, more or less, trains have been run on the theory that every engineman knows the location of every fixed signal, knows its kind by its location, and knows enough landmarks along the line to enable him to stop at the signal (or at that place, if the signal has been destroyed) if he desires to stop there. In establishing distant signals we have perhaps relieved runners from this requirement to a slight extent; though no runner who takes any pride in his "profession" would be willing to be classed among those who must see a distant signal before they know they are approaching it. If such a long-standing and fundamental principle is not fully lived up to by the enginemen and by the officers whose duty it is to make them live up to it, and if in consequence of such laxity they have troubles—why, that should not trouble the signal engineer!

WOODEN CARS IN THE SUBWAY.

The accident last week in the unfinished section of the West Side branch of the New York Subway, described elsewhere in this issue, was a striking object lesson in the relative fire-resisting qualities of steel and wooden cars. About four weeks ago, at the time of the strike, a rear end collision, in which both steel and wooden cars were damaged, showed in an equally striking manner

the difference in the strength of the two types of cars. The copper sheathed wooden cars which were built for the Subway were a distinct advance in car construction for electric roads at the time they were designed, three years ago, and they are about as strong and as thoroughly protected against fire as it is possible to build a wooden car. They have steel sills, composite wood and metal platform and end framing construction and heavy trussed side frames. The floor is protected against fires from short circuits under the car by steel plates and non-combustible filling around the sills, and the sides are sheathed with copper covered siding, which is an effective protection against fire from the outside. The wood used was impregnated with fireproofing compound, which makes it at least slow-burning, and in every way possible precautions were taken against fire and the effects of telescoping in collisions. That these precautions were futile in both of the accidents which have recently occurred is not so much an argument against the wooden car as it is an argument for the steel car. In the collision which took place, a wooden car was coupled between two steel cars in the rear of the train which was standing at the station, and the rear steel car was struck by another steel car at the head of the following train. Most of the injured passengers were in the wooden car, which was crushed between the two steel cars. Neither the last car of the standing train nor the first car of the following train was seriously damaged. Similar accidents happen almost daily on steam roads in which wooden cars coupled between steel cars are badly damaged in collisions, although not actually struck, while the latter are only slightly battered. The fault is not altogether with the wooden cars but rather in attempting to run them between two cars of a much stronger construction. The result of a collision between two trains of wooden cars would be not much more damaging than a collision between two trains of steel cars, but in a collision between a train of steel cars and one of wooden cars, all of the damage would probably occur to the latter. The wooden cars in the Subway are stronger and safer in every way than the wooden cars on the elevated lines, and if they were run in mixed trains with them the results of a collision would be similar to those which took place in the Subway accident. When run by themselves in solid trains they are quite as safe as there is any need for cars to be for service on the elevated lines, and their use would increase the carrying capacity of those lines to an appreciable extent.

The accident of last week which was followed by a fire in the tunnel developed nothing not already discussed in these columns. Fortunately the test of the steel cars in a fire was not accompanied by any loss of life, except the fireman who was killed on entering the tunnel after the fire was out, and the result of the accident can be viewed in the light of an interesting comparison instead of as an awful lesson, as was the fire in the Paris underground railway. We pointed out at the time the wooden cars were first built that while the fireproofing applied in the sides and floor would prevent a fire caused by a short circuit under the car from seriously damaging the car, it would be useless in protecting the cars in case of a wreck which would splinter the wood, or in case the cars were exposed to a large fire near them. It was not to be expected that the steel cars would be destroyed themselves or furnish fuel to any fire to which they might be exposed, because there was nothing in them to burn except the cane seat covers and the advertising signs, nor did the fire in the tunnel disprove these expectations in any way. The wooden cars were totally consumed, and by their burning caused as much damage to the tunnel as the burning of the timbering and other combustible matter used by the contractors who were at work. Although the steel cars were subjected to a heat intense enough to melt the aluminum interior fittings, they were left structurally intact, and were not even badly warped. Had all of the cars in the wrecked train been of steel it is very probable that the fire might have been controlled before it burned itself out and much of the damage to the masonry in the tunnel could have been prevented.

The rapidity with which the fire spread after the wreck shows what might be expected in case of an accident to a train of wooden cars filled with passengers. By the time the fire department arrived it was impossible to enter the tunnel at either end, and if there had been passengers on the train, many of them would have been suffocated by the smoke before reaching an outlet. Every precaution against fire which has been embodied in the equipment of the Subway would probably have been quite useless in preventing a large loss of life, and there would have been a repetition of the Paris Metropolitan disaster. Both of the accidents which have been referred to, have shown clearly the greater safety of the steel car both in collision and in fire. Wooden cars in the tunnel are a menace though they may be safe enough on the elevated lines where the speeds are slower, the liability of accident less and the danger from fire practically nothing. No more of them in all probability will be supplied for the underground lines, but it would be a safe move on the part of the Interborough Company to replace with steel cars as fast as possible all that are at present in use and transfer them to the elevated roads. So long as they are in use in mixed trains with steel cars, they add to the danger of collisions and the danger from fire cannot be entirely eliminated until all are taken out.

The railroad commissioners of Georgia have decided that the railroads of the state must not increase the minimum car load rate in their tariffs for freight carried in extra long cars. In the same decision a limit is put in the other direction; the commission having prescribed a minimum car load weight and rate for any commodity, that commodity must be carried at that rate, even if the shipment requires more than one car. This is a fine stroke of state-made economy. To carry goods at the lowest cost it is necessary to use large cars and to load them full; but this Georgia rule compels the roads to make a separate rate for each size of car, or else be constantly carrying partial loads of bulk freight; and, what is more important, will compel them to maintain a largely increased stock of cars; for each station will be expected to be ready to give to a shipper a car of any size on any day. In time the freight cars of the country will probably be all of maximum length and of high capacity and a rule like this will work no injury; but that is some distance in the future. A road already owning a large proportionate number of 50-ton cars might at once reduce rates for carrying full loads in such cars, and thus induce shippers to ship in large quantities; but if railroad commissions continue to be ruled by the spirit that has prevailed hitherto in most of our states, an order might be expected soon from some state requiring the reduced rates offered for goods carried in such cars to be applied to car loads in 25-ton or 20-ton cars. It is a legitimate means of promoting economy to charge higher rates for smaller shipments, but state commissioners, conceiving their office to be mainly that of a friend to the small shipper, are not likely to feel a very warm interest in the idea. In view of the losses incident to the maintenance of several different sizes of cars, probably the only thing for the Georgia railroads to do is to submit to the change. It is true that 25-ton loads had better be carried in 50-ton cars a good many times in the year rather than to build special 25-ton cars, which, probably would only rarely be where they were wanted for use. But what a fine opportunity this rate-making would offer to a Government officer on a state railroad who desired to please the people at the expense of economical operation!

New York Central & Hudson River.

Owing to the change in date for closing the fiscal year from June 30 to Dec. 31, a supplemental report has been issued, bringing the returns up to the close of 1904, for subsequent comparisons and to complete the record. The previous report, for the year ending June 30, 1904, showed alarming increases in operating costs, accompanied by only a slight gain in earnings, and by a consequent falling off in net. Most of the roads in the country showed a similar result last year, in greater or less degree, but it was particularly marked on the New York Central. The corner has now been turned, however, and the half-year's report at hand shows a substantial gain in gross earnings, as compared with the same six months of 1903, accompanied by a substantial decrease in operating cost. Gross earnings were $42,100,406, a gain of $890,987, while operating expenses were $27,828,272, a decrease of $252,539. Prior to net earnings, however, $1,215,623 was charged to betterments, as against $600,760 during the same six months of 1903, but net earnings, amounting to $13,056,512, were still $528,663 higher than in the previous period. Other income increased $462,755, bringing gross income up to $16,217,740, and net income, after deducting fixed charges and taxes, was $5,222,007, as compared with $5,083,131.

Taking up the earnings and expenses in detail, it is interesting to note that the percentage of increase of passenger traffic was less than the percentage of increase of freight traffic. With the stimulus of the St. Louis fair and the general building up of the country, the reverse has been true in most of the recent reports. So far as the number of passengers carried is concerned, the gains for the year were in the local and commutation business, rather than in the longer hauls, which would indicate that the St. Louis fair did not prove a business maker. But the company reports that most of the increase in passenger earnings was, nevertheless, due to better returns from long haul, interline tickets, although the number of these tickets sold decreased. Freight earnings increased from $23,856,937 to $24,555,515, due to an increased movement of low-class commodities and a slight increase in the average rate. Of specific commodities carried, the largest increases were lumber,

increased 351,208 tons; anthracite coal, 278,216 tons; ores, 200,047 tons, and fruit and vegetables, 165,945 tons. The only important decrease was grain, 157,912 tons.

The expense account shows an increase in the charge for maintenance of way and structures from $4,865,086 to $5,228,426. Maintenance of equipment decreased about a similar amount, and conducting transportation decreased from $15,741,967 to $15,523,037. The increase under the first heading is attributed to general repairs to roadway and tie renewals, while the decrease in the maintenance charge for cars and marine equipment more than offset a heavier locomotive repair bill. The saving in the cost of conducting transportation was due primarily to two causes; decrease in the cost of fuel, in place of the increases of recent years, presumably due to the company's new operations in the coal territory, and a decreased charge on account of rents for tracks, yards and terminals. The saving under the latter heading is mainly a matter of bookkeeping, since payments for the use of joint facilities on a fixed interest basis covered by this account in 1903 were included in the first charges in 1904. An increase of $169,844 is reported in the per diem account, due to the greater number of cars handled, and to the difficulty in obtaining prompt return of New York Central equipment from other roads.

Mention is made in the report that on July 16, 1904, the company acquired a substantial interest in the local trolley lines in Rome, Oneida and Syracuse, and in the Utica & Mohawk Valley road, running from Rome to Little Falls through Utica and other points. It is planned to connect the Utica & Mohawk Valley system with the Oneida road, and from Oneida, electric cars will be run over the West Shore into Syracuse.

During the half year under review, a total of $1,092,208 has been spent in connection with the electrification in the vicinity of New York. This includes expenditures on account of power houses, excavation for the new depressed yard at the Grand Central terminal, four-tracking a portion of the suburban lines, etc. It is also announced that the plans of the new Grand Central station building have been submitted to the city authorities for approval. A successful test of the first electric locomotive was made on Nov. 12, as fully described in a previous issue of the *Railroad Gazette*.

No new capital stock was issued during the six months ending Dec. 31. The funded debt was increased $26,500,000 by the issue of 4 per cent. gold debentures. The profit from operation, after payment of the usual dividend, was $1,765,757, and from this amount $1,500,000 was appropriated as a special fund for new equipment and betterments, the balance being carried to the credit of income account.

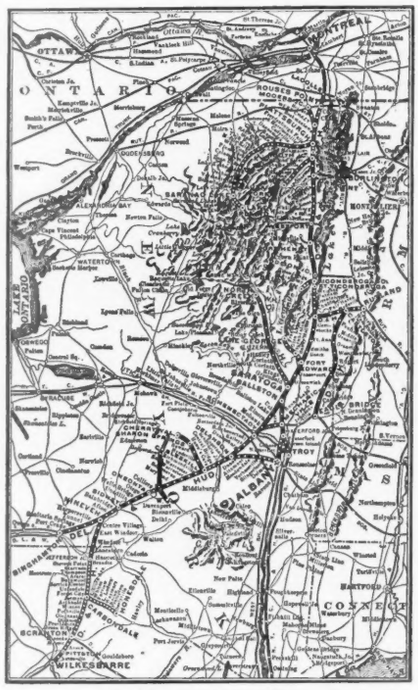
The principal statistics of operation may be summarized as follows:

	Six months of— 1904.	1903.
Average mileage	3,515	3,482
Freight earnings	$24,555,516	$23,856,937
Passenger earnings	13,710,395	13,586,482
Gross earnings	42,100,406	41,209,419
Main. way and structures	5,228,426	4,865,086
Maintenance of equipment	6,050,748	6,448,934
Conducting transport.	15,523,037	15,741,967
Total expenses	27,828,272	28,080,811
Add chg. for betterments.	1,215,623	600,760
Net earnings	13,056,512	12,527,849
Gross income	16,217,740	15,226,322
Net income	5,222,007	5,083,131

Delaware & Hudson.

The Delaware & Hudson operates 843 miles of line from Wilkesbarre, Pa., through the Wyoming Valley, and in a general northeast direction to Rouse's Point, south of Montreal, on the line between New York State and Canada. Unlike all the other anthracite roads, it has no line into New York, and very little share in through traffic. It must, therefore, depend largely on its coal business, and the figures of its seventy-fifth annual report clearly show that the company's present prosperity is based on its ownership of coal lands and control of coal traffic. Gross earnings from all departments for the year were $34,655,113, 74 per cent. of which came from the coal business. Of this amount, $19,032,413 came direct from the sales department, and $6,526,018 of the $15,071,124 total gross railroad earnings, from the transportation of coal. The total net earnings were $7,452,479, less interest and rentals of $2,999,957, leaving $4,452,522 as net fncome for the year after all charges, being 11.06 per cent. on the capital stock ($35,000,000 until March 31st, and $42,000,000 thereafter). Dividends at the rate of 7 per cent., amounting to $2,756,163 were paid; $1,500,000 was charged to profit and loss and credited to the account of mining plant, and the balance of the net income, $196,360, was credited to profit and loss.

The Delaware & Hudson, although running nearly in a straight line, is really more like two railroads under one name than a through



Delaware & Hudson.

route. On the southern end of the road, coal is by far the most important part of the traffic, while the northern end is largely a tourist line carrying passengers and freight to the Adirondack region and Montreal. The central part of the line, the region about Albany, combines a large traffic in the distribution of the coal hauled from the mines, with, on the Saratoga division, a large passenger traffic.

Of the total passenger earnings of $2,842,964, the Pennsylvania, Susquehanna and Champlain divisions, aggregating 594 miles, earned $1,729,829, against $1,113,133 on the Saratoga Division of 249 miles. At several points the competition of electric lines has been severely felt, particularly between Wilkesbarre and Scranton, where the Lackawanna & Wyoming Valley parallels the line, and between Albany and Lake George, which are connected by the Hudson Valley. The recent move by the Delaware & Hudson in acquiring, together with the New York Central, control of the Schenectady (Electric) Railway and the reduction of passenger fares between Wilkesbarre and Scranton, shows that active efforts are being made to meet such competition. Since there is an increase for the year in total passenger earnings, the decrease in passenger earnings of $29,776 on the Pennsylvania Division, and $41,182 on the Saratoga Division, are probably due to this source.

The earnings from coal were, on the Pennsylvania Division, $2,943,748, which is 76 per cent. of the total freight revenue of $3,873,543, and 68 per cent. of the total railroad earnings of $4,332,168. On the Susquehanna Division coal earnings were $2,773,464, or 56 per cent. of the total freight revenue of $4,951,065, and 49 per cent. of the total earnings of $5,674,166. On these two divisions, passenger earnings were only 10 to 12 per cent. of the total. Beyond Albany, on the Saratoga and Champlain divisions, passenger earnings were considerably larger than the earnings from coal, amounting, on the Saratoga Division, to 34 per cent. of the total, and on the Champlain Division to 25 per cent.

The total mileage operated was 843 miles, including 22 miles of trackage over the Erie, from Binghamton west to Owego, acquired during the year. The total length of first, second, third and fourth tracks, excluding yard tracks and sidings, was 1,121 miles in 1904 and 1,095 miles in 1903. On this basis, maintenance of way figures out at $1,539 per mile of single track ($2,101 per mile of line) in 1904, against $1,441 per mile of single track ($1,922 per mile of line) in 1903. Maintenance of equipment was *$1,744 per locomotive against *$1,186 in 1903; $381 per passenger car against $321 in 1903, and $43 per freight car against $41 in 1903. Fifty locomotives, 20 passenger cars, three cafe cars, one baggage car, two combination cars, 100 flat cars, 50 coal cars, six milk cars, and 15 company cars were purchased or built during the year. Conducting transportation cost $6,145 per mile (843 miles) in 1904, and $5,560 per mile (821 miles) in 1903, an increase of $585 per mile. Gross earnings of the railroad department were $17,878 per mile in 1904 against $16,617 in 1903, an increase of $1,261 per mile. Expenses were $10,908 per mile in 1904 against $9,950 per mile in 1903, an increase of $958. Net earnings were $6,970 per mile in 1904, and $6,667 per mile in 1903, an increase of $303 per mile. These figures are remarkable in view of the fact that like all the other anthracite roads, earnings in 1903 showed a very large increase to make up for the losses during the strike of 1902.

Traffic statistics show an increase of 2,824,380 passengers carried one mile per mile of road over 1903, an increase in the number of tons of revenue freight from 15,009,808 in 1903 to 15,612,163 in 1904, and in the average haul of one ton from 108 miles in 1903, to 114 miles in 1904. Total freight earnings increased from $13,895 per mile of road in 1903, to $14,346 per mile of road in 1904. The average number of tons of freight per train was 420.39 in 1904, against 393.32 in 1903. There was a decrease during the year in anthracite coal carried of 402,425 tons, but an increase of 241,015 tons in bituminous coal, probably partly due to a traffic agreement with the Pennsylvania by which freight is received from that road at Wilkesbarre and carried through to New England and Canadian points. This seems to show that even the traffic of the anthracite roads is feeling the increased consumption of bituminous coal taught by its enforced use during the strike. Of the total increase of 602,355 tons of freight carried, 386,434 tons were in merchandise and miscellaneous commodities said to be due in part to a traffic agreement with the Lehigh Valley for exchange of freight between New England and the West. This is a healthy sign, for it shows that the road is increasing its general business and is,

*These figures include simply the item "Repairs of Locomotives."

therefore, proportionately less dependent on its anthracite traffic.

An increase of 100,000 shares in the capital stock of the company was authorized March 7, of which amount 70,000 shares, or $7,000,000 at par, were issued to the stockholders at 135. The proceeds were used to pay the outstanding bonds and debentures of the New York & Canada Ry., amounting to $5,000,000, the outstanding bonds of the Chateaugay Ry., amounting to $200,000, and the expense of standard gaging the Chateaugay & Lake Placid, amounting to $2,065,778, the balance being applied to the general purposes of the company.

The company is noteworthy in the liberal allowance made each year for betterments, and particularly for depreciation account. During the past year, $1,193,782 was appropriated out of earnings for betterments, and $4,613,661 was written off various accounts for depreciation. This included the items of $1,790,559 charged off Railroad Equipment, and $1,500,000 charged off mining plant, washeries, etc. The stockholders ordinance of May 9, 1899, provided for the establishment of a sinking fund "for the gradual retirement of stock and bonds of the company contemporaneously with the mining and sale of its coal," and for "crediting thereto each year upon the books of the company a sum equal to not less than five cents for every ton of coal mined by the company during the year, and any additional amount which the managers may deem expedient," which "sum shall be charged against the profits for the year and shall be invested in the securities of the company which shall forthwith be retired and canceled.' In accordance with this provision, 4,171 shares of Delaware & Hudson capital stock were purchased and canceled at an expense of $609,000. The total amount of capital stock at the end of 1903 was $34,407,100, which was increased by the new issue of $7,000,000, and decreased by the $417,100 canceled from the sinking fund, leaving a total of $40,990,000, a net increase of $6,582,900.

With its large annual betterment and depreciation accounts and its ownership of 218,644,000 tons of unmined coal, the Delaware & Hudson seems to have an assured prosperity for many years. The report also shows evidences that the company is taking more effective steps than the establishment of a sinking fund against the time when its coal supply shall be exhausted by increasing its tonnage and haul of other commodities.

The principal statistics of operation follow:

	1904.	1903.
Mileage worked	843	821
Freight earnings	$12,092,260	$10,690,700
Passenger earnings	2,842,962	2,810,595
Gross earnings	15,071,124	13,642,953
Main. way and structures.	1,724,931	1,577,746
Maintenance of equipment	1,574,874	1,386,187
Conducting transportation	5,180,335	4,564,754
Operating expenses	9,195,281	8,169,196
Net earnings	5,875,843	5,473,757
Gross earnings*	34,655,113	34,186,371
Net earnings.*	7,452,479	7,094,207

*From all departments.

Northern Central.

The general returns from the Northern Central were included in the main Pennsylvania report, reviewed in the issue of March 3. The detailed report of the company is now at hand. On a mileage of 448, practically unchanged from last year, the Northern Central earned $10,288,204, as against $10,310,086 last year. Operating expenses were $7,829,253, a substantial decrease, leaving net earnings $2,458,951, as against $2,336,209 last year. The decrease in gross earnings is attributable wholly to the passenger traffic, which fell off about $83,000. Freight traffic showed a slight gain, but not enough to offset the decrease from carrying passengers. In the expense account, conducting transportation showed an increase of about $71,000, which was considerably more than offset by a decrease of almost $163,000 in the charge for maintenance of way and structures and a decrease of $59,000 in the charge for maintenance of equipment. The aggregate net income after the addition to net earnings of interest on investments and a deduction of fixed rentals on leased road fixed charges, taxes, etc., amounted to $2,077,131, as against $1,847,094 last year. The same device is followed in reporting the cost of traffic and of operations separately under the head of conducting transportation, which received comment in the review of the main Pennsylvania report. Ton mileage and freight train mileage both decreased somewhat, with a slight gain in the average ton-mile rate. The average train load was 401 tons, a decrease of 5¼ tons.

After providing for the regular 8 per cent. dividends and for the sum due on account of the principal of car trusts, the balance of income remaining, $920,681, was appropriated for extraordinary expenditures. The full amount of these expenditures during the year was $1,680,013, leaving a balance of $759,331 to be otherwise provided for. This was taken care of by the proceeds resulting from the premium received on stock allotment and a profit resulting from the sale of securities and from the adjustment of accounts during the year. An additional $750,000 was transferred out of the same account to a general extraordinary expenditure fund to defray the cost of future improvements and betterments. The extraordinary betterment work during the year includes the completion of the four tracking from New Cumberland to York Haven and the payment of the Northern Central's portion of the cost of the large joint terminal yard at Fairview, on the west side of the Susquehanna river, of which three-quarters was borne by the Pennsylvania Company and one-quarter by the Northern Central. This yard is now in service, although its track system is not yet fully completed, and it has greatly expedited the movement of coal and of other heavy east-bound traffic.

The table showing the classification of freight traffic shows the only important increases of the year to have been the tonnage of anthracite coal and of fruits and vegetables. There were considerable decreases in grain, flour, bituminous coal, coke, iron and steel rails. The principal statistics of operation follow:

	1904.	1903.
Mileage worked	448	449
Freight earnings	$7,994,923	$7,977,121
Passenger earnings	1,734,372	1,817,418
Gross earnings	10,288,204	10,310,086
Main. way and structures.	1,092,956	1,225,717
Maintenance of equipment.	1,890,764	1,950,277
Conducting transportation.	4,684,827	4,613,588
Operating expenses	7,829,253	7,973,878
Net earnings	2,458,951	2,336,209
Gross income	3,096,203	3,066,550
Net income	2,077,131	1,847,094

TRADE CATALOGUES.

Air Power.—Number 2 of this little quarterly issued by the Rand Drill Co., is at hand. It contains 22 pages, well printed, on good paper, and has a long illustrated article describing the natural gas pumping plant at Hundred, W. Va.; an illustrated paper on the Graphics of Boyle's Law, one on Economy in the Operation of Coal Mine Power Plants, and several short illustrated articles. Communications may be addressed to P. F. Kobbe, Jr., Advertising Manager, Rand Drill Co., 128 Broadway, New York.

Valves.—The Crane Company, Chicago, Ill., is distributing its March issue of "The Valve World." This is the third number of this interesting monthly published by the above company. It contains a number of articles on mechanical subjects of interest to railroad men, as well as description of the different devices made by the Crane company. The last two pages are devoted to general trade news.

Hollow Staybolts.—The Falls Hollow Staybolt Co., Cuyahoga Falls, Ohio, has collected a number of letters from satisfied users of hollow staybolts and is sending them out in a small pamphlet. An introductory paragraph points out some of the advantages of this form of staybolt.

Steam and Oil Separators.—Crane Co., Chicago, has just issued an advance circular No. 01, describing Crane steam and oil separators, for the separation of water from live steam and the elimination of oil from exhaust steam. It will be sent on request to those interested.

International Railway Congress.

Secretary W. F. Allen has published a programme for the Washington meeting (May 4-13) from which the following items are taken:

April 29 to May 2.—Arrival of delegates.

Wednesday, May 3.—From 11 a.m. to 2 p.m., registration of members at the office of the General Secretary of the Permanent Commission at the New Willard Hotel, Washington.

Thursday, May 4.—11 a.m., formal opening at the large banquet hall of the New Willard Hotel. Vice-President Fairbanks has consented to act as honorary president, representing the Government of the United States.

The Sections will meet as follows:

First Section.—At the Ebbitt House.

Second Section.—At the New Willard, north end.

Third Section.—At the New Willard, south end.

Fourth Section.—At the Raleigh.

Fifth Section.—In the hearing room of the Interstate Commerce Commission, F street.

For the entertainment of delegates the following tentative programmes have been arranged:

NEW YORK CITY, MONDAY, MAY 1.

9 a.m.—Leave Transportation Club. Inspect Grand Central Station and yard.

10 a.m.—Take Subway from Grand Central Station to north end of line; then to City Hall and return to Thirty-third street.

11.30 a.m.—Take electric vehicles from Thirty-third street to Thirty-fourth street ferry.

11.45 a.m.—Take special ferry boat to Long Island City.

11.55 a.m.—Inspect tunnel shafts and Pennsylvania Railroad power house.

1 p.m.—Take steamer from Long Island City to Ninety-sixth street power house. Lunch on boat.

2.30 p.m.—Down river on boat, around the Battery, stopping to inspect Pennsylvania Railroad, Jersey City Terminal, passing Central Railroad of New Jersey, Lehigh Valley Railroad, Erie Railroad, Delaware, Lackawanna & Western Railroad, West Shore Railroad and New York Central freight terminals. To Grant's tomb and return to Fifty-ninth street. Inspect power station of Interborough Rapid Transit Company.

6 p.m.—Electric vehicles to Transportation Club.

PHILADELPHIA, MAY 2.

The delegates, coming from New York, will be taken to the works of the Baldwin Locomotive Company, where a complimentary lunch will be tendered the delegates by that

company. On leaving the works, the party will be taken by open trolley cars furnished by the Philadelphia Rapid Transit Company, to give them some idea of the city, with possibly a visit to Independence Hall and a reception by the local committee.

WASHINGTON.

Wednesday, May 3.—General view of Washington. The elevators of the Washington Monument will be placed at the disposal of the committee in the morning.

It is expected that the opening ceremonies of the Railway Supply Exhibition will be arranged for the afternoon. If it can be arranged the midnight signal around the world will be despatched at midnight.

Thursday, May 4.—Excursions to Mt. Vernon in the afternoon.

Friday, May 5.—Expeditions to various public buildings with French speaking guides. Special cars will be provided by the street railway companies of Washington.

Saturday, May 6.—Open.

Monday, May 8.—Visits to the Departments of State, War, Navy and Treasury.

Tuesday, May 9.—Visit to new Union Station. Banquet by the American Railway Association to the Foreign Delegates in the evening.

Wednesday, May 10.—Visit to the Navy Yard and gun foundry.

Thursday, May 11.—Visit to the Smithsonian Institute and National Museum. Banquet by the American Railway Association to the foreign delegates in the evening.

Friday, May 12.—Visit to the Pension Office.

Saturday, May 13.—The delegates will be taken by trolley cars to Arlington, and thence to the Army Post at Fort Meyer, where the Secretary of War expects to arrange for an exhibition drill of the troops stationed there.

A special edition of a descriptive guide to Washington will be prepared for the use of the delegates.

It is expected that the delegates will be received by the President or Vice-President at the White House at some date during the Congress, probably on May 5. A number of private receptions will also be tendered.

TOURS OF INSPECTION FOR FOREIGN DELEGATES.

The itinerary of these tours will be announced by Geo. W. Boyd, Vice-Chairman of the Committee on Itinerary. The itinerary will be about as follows:

The Short Tour.—Leave Washington, Sunday evening, May 14. Visits to Altoona, May 15; Pittsburg, May 16; Cleveland, May 17; Buffalo (including Niagara Falls), May 18 and 19; Schenectady, May 20, and Boston, May 21 and 22. The party will arrive on the return at New York, Tuesday morning, May 23. The total length of this trip is about 1,500 miles.

The Long Tour.—Leave Washington, Sunday evening, May 14. Visits to Altoona, May 15; Pittsburg, May 16; Cincinnati, May 17; St. Louis, May 18; Chicago, May 20, 21, 22; Buffalo (including Niagara Falls), May 23; Montreal, May 24; Saratoga, May 25; Schenectady, May 26. The party will arrive on the return at New York, Saturday evening, May 27. The total length of this trip is about 2,700 miles.

Programmes have been arranged at each of the cities visited, which will enable the delegates to inspect the various industries, terminals and other objects of interest to the best advantage.

A special train will be provided for each tour, provided with an interpreter, a stenographer and a ladies' maid. When night runs are to be made, the delegates will sleep upon the train, in which case dinner and breakfast (coffee) will be supplied in the dining and buffet cars, as guests of the American railways. When stops are made over night in cities, list of hotels (and their prices) will be furnished, at which the delegates will remain as they may select.

William Frederick Potter.

We have to record the death of Mr. W. F. Potter, President of the Long Island Railroad, only three months after that of his predecessor, Mr. W. H. Baldwin, Jr., an inexpressibly sad ending of a beautiful life. We gave a sketch of his character in these columns on his promotion (January 20, page 20, of the news section) but, solely out of consideration for Mr. Potter's modesty, refrained from praising his amiability and candor and his engaging simplicity of manner. Every one who was at all acquainted with him felt these qualities. We are glad to supplement our own sketch by the following words from one of Mr. Potter's subordinates:

"Mr. Potter was an ideal man; a loving and devoted husband and father; a man with lofty ideals, broad-minded, liberal, just, and as Christlike as man could be. There was not a trace of littleness in his nature, and

William Frederick Potter.

he was beloved by every one of the thousands of employees, from the laborer and his wife and little ones to the officials who carried out his wise dictates. The instances of his goodness are so many and so varied that I should have to take the morning of the first day I met him and follow him through every day of the years that I knew him to recount them all. It seemed that he lived to let each succeeding day be more blessed than the last and to make everyone with whom he came in contact the happier."

The immediate cause of Mr. Potter's death on April 2 was cerebro-spinal meningitis, with which he was sick nearly a month, most of the time unconscious. It is, of course, a gross exaggeration to say that the disease was brought on through criticisms of the policy of the company in increasing certain commutation passenger rates, but it does not require imagination to convince anyone who knew Mr. Potter that this criticism was indirectly contributory. He felt the attacks keenly and was sensitively solicitous concerning the attitude of the critics. That he was not directly responsible for the policy did not lessen the burden. His endeavors to justify the position of the road through open letters in the advertising columns of the daily newspapers were indicative of his fine sense of justice and fair play and his confidence in the force of reason as against clamor. The strain undoubtedly undermined his health and made him susceptible to disease. The name of William Frederick Potter is thus added to the long list of efficient railroad men whose devotion to duty brought life to an untimely end. Mr. Potter was not quite 50 years old. He leaves a widow and three children.

Locomotive Tests at St. Louis.*

TESTS OF PENNSYLVANIA RAILROAD CONSOLIDATION LOCOMOTIVE NO. 1499.

Previous bulletins have described the organization for carrying on the work, its plan and scope, the location of the plant, and its essential features and the methods to be followed in making the tests. The schedule originally outlined by the Advisory Committee provided for the testing of 12 locomotives, but owing to difficulties and delays not within the control of those in charge of the work, it has been impossible to carry out the complete schedule. Tests under starting conditions were not attempted owing to the slipping of drivers causing flat spots on the supporting wheels.

The delays which have occurred have been due, largely, to incidental causes such as hot bearings, arising from poor distribution of oil, from the chain oilers, on the bearings of the supporting axle journals, flat spots on the supporting wheels, fluctuations in water pressure and to the necessity for experimenting with oils to determine the best lubricant for use in the absorption brakes. Considerable time was occupied in fitting oil cups and felt strips in the caps of the bearings in the place of chain oilers.

At high speeds the backward and forward motion of the locomotives, caused a reversal of stress on the drawbar, which prevented tests at speeds above those recorded. This trouble was overcome in later tests, by placing oil dash pots between the tail piece of the locomotive and the dynamometer housing.

Engine oil was first used in the brakes, then ½ engine oil and ½ valve oil, then all valve oil and finally, ⅛ castor and ⅞ valve oil. The more viscous oils gave the best results, as the energy absorbed by the oil increases as the viscosity increases, thus permitting a lower water pressure to be maintained on the brakes. The water used in the tests was taken from the city mains, which drew their supply from the Mississippi river. At certain times there were violent fluctuations in the pressure of the water supply, these being transmitted to the absorption brakes, causing difficulties in handling the locomotive at the required speed, and in some cases causing slipping of the drivers and hence flat spots on the tires of the supporting wheels. In general, however, the operation of the plant has been found satisfactory, which shows that great care was exercised in the designs. The water used by the boilers of the locomotives under test was treated by a Kennicott water softener.

Before the tests were begun, considerable time was spent in making analyses of coal in order to get a bituminous fuel having high fixed carbon, little ash, producing little smoke, and with as little tendency to clinker as possible. That finally accepted was furnished free of charge by the Berwind-White Coal Mining Company, from their Scalp Level mines near Johnstown, Pa. The coal was of very good quality but friable, and when the draft was strong a good deal of the fine portion was drawn through the tubes into the smoke-box. The heating value per pound of dry coal averaged more

*From Bulletin No. 4 published by the Pennsylvania Railroad Company.

than 14,000 British thermal units and a proximate analysis of it follows:

Fixed carbon	75.85 per cent.
Volatile combustion	16.25 "
Ash	7.00 "
Moisture	0.9 "
Total	100.00 per cent.
Sulphur determined separately	0.90 "

An ultimate analysis of an average sample of the coal is as follows:

Carbon	84.20 per cent.
Hydrogen	4.28 "
Nitrogen	1.44 "
Oxygen	2.94 "
Sulphur	0.80 "
Ash	6.34 "
Total	100.00 per cent.

In preparation for a test, the locomotive was gradually worked up to the desired conditions and then run 10 or 15 minutes longer before observations for the recorded data were made. A warning signal of four bells was given five minutes before the test began, and 15 seconds before each reading a signal of two bells was sounded, one bell being sounded for the time of observation.

Up to the time of starting, the coal and water used were taken from unweighed supplies. At the signal to start a box of weighed coal was dumped on the firing platform. The heights of water in the boiler and the feed water tank were then noted and thereafter all coal and water was carefully weighed. At the conclusion of the test the water levels were brought to the heights noted at the beginning of the test.

After the last observation the log sheets were worked up by the observers and checked after which they were handed to the computers. As the readings were taken, the principal items were plotted on a graphical running log. Any irregularities or inconsistencies were hence immediately made known.

The normal testing force was as follows:

Position.	No. of men.	Position.	No. of men.
Director of tests	1	Coal observer	1
Assistant Director of tests	1	Pyrometer observer	1
Editor	1	Calorimeter observer	1
Foreman of tests	1	Water observers	2
Foreman of plant	1	Indicator observers	2
Stenographer	1	Watchman	1
Chemist	1	Craneman	1
Computers	3	Oilers	2
Brake-wheel operator	1	Wipers	3
Dynamometer observer	1	Machinist	1
Cab observer	1	Draftsmen	2
Speed and draft-gage observer	1	Engineman	1
Brake observer	1	Firemen	2
		Total	35

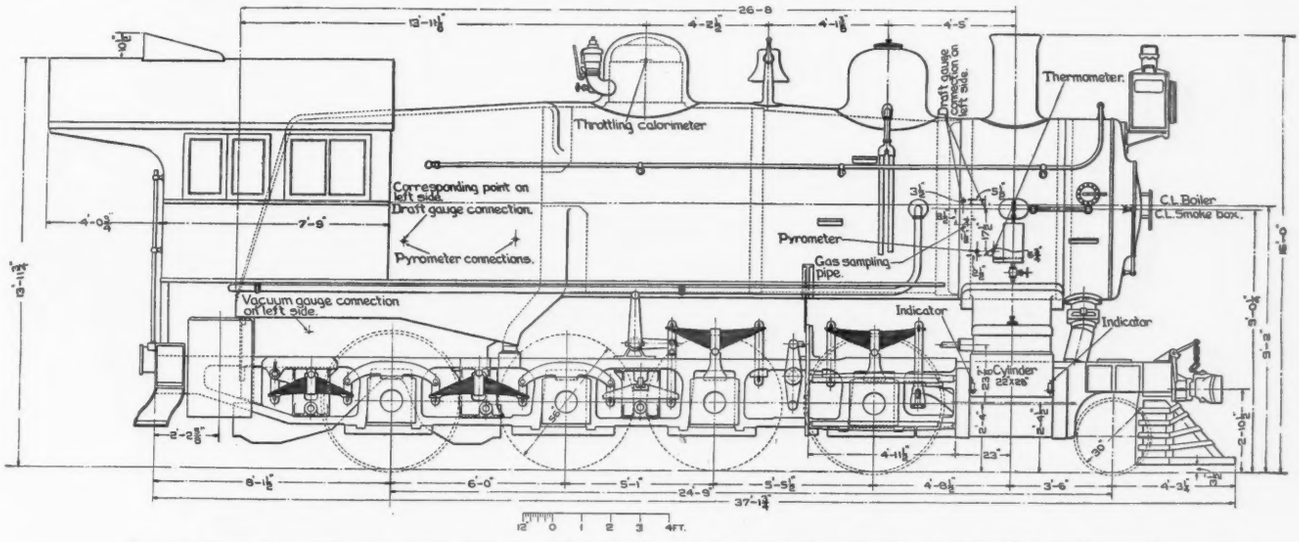
Description of Locomotive.

The first locomotive placed on the testing plant was No. 1499 owned by the Pennsylvania Railroad Company. It is of the consolidation (2-8-0) type, and is the standard heavy freight locomotive used on the Pennsylvania Railroad. It is known as the "H6a" type according to the railroad company's classification. The locomotive was new and had not been thoroughly broken in before being tested. The first official test was made on May 25th, the locomotive having been run previously for three weeks in order to break in the plant. The principal nominal dimensions are shown in the following table:

Total weight, lbs.	194,200
Weight on drivers, lbs.	173,200
Cylinders (simple), ins.	22 x 28
Diameter of drivers, ins.	56
Firebox heating surface, sq. ft.	166.4
Heating surface in tubes (water side), sq. ft.	2,677.27
Total heating surface (based on water side of tubes), sq. ft.	2,843.67
*Total heating surface (based on fire side of tubes), sq. ft.	2,482.26
Grate area, sq. ft.	49.2
Boiler pressure, lbs.	205
Valves	Richardson balanced
Link motion	Stephenson
Firebox, type	Belpaire
No. of tubes	373
Outside diameter of tubes, ins.	2
Length of tubes, in.	164.5

*Used in calculations as stated in Bulletin 3.

The maximum tractive effort is 39,773 lbs., which is calculated on the assumption that 80 per cent. of the boiler pressure (205 lbs.) is available as mean effective pressure at starting. On this basis the ratio of weight on drivers to maximum tractive effort is 1:4.35.



General Elevation of Pennsylvania H6a Consolidation Locomotive showing Positions of Testing Instruments.

Tests.

The tests which have been run, together with the laboratory designation and dates of running, are as follows:

Test No.	Laboratory designation.	Date.
101	160-40-P	June 11
102	160-20-F	June 7
103	80-20-F	May 25
104	160-45-P	June 10
105	160-27-F	" 9
106	160-34-F	" 8
108	80-40-F	" 15
109	80-20-F	" 4
110	40-20-F	" 16
111	40-30-F	" 18
112	80-30-F	" 20
113	160-30-F	" 20
114	160-50-P	" 21
115	120-35-F	" 21
116	120-30-F	" 22
117	160-35-P	" 22
118	80-37-F	" 24

In the laboratory designation the first figure indicates the approximate speed in revolutions per minute, the second figure indicates the approximate cut-off in per cent. and the letter indicates the position of the throttle lever, whether fully open (F) or partly open (P).

Owing to evident inconsistencies, shortness of tests, etc., the results obtained from tests Nos. 104, 106, 108, 113 and 114 have not been plotted on the diagrams. Some of these tests determine the maximum boiler power.

The performance of a locomotive naturally divides itself into three parts relating separately to the boiler, the engines, and the locomotive as a whole.

As already outlined in Bulletin 1, the performance of this and the other locomotives which have been tested, will be considered under the several heads as above noted. By having a separate presentation of the engine and boiler performance, it will be possible to make accurate comparisons and predict with reasonable certainty the effects of interchanging the boilers and engines of different locomotives.

In the following discussions the headings of the columns are self explanatory. The number at the head of each column of the tables corresponds with the number used in the table of recorded data shown in full in the appendix which accompanies the bulletin. When no number is used, the column represents items calculated from the recorded data.

BOILER PERFORMANCE.

General Conditions.—Table 1.

The tests are arranged in order, according to the rate of equivalent evaporation. It will be noted that no recorded test was shorter than 130 minutes, while the longest was 210 minutes.

The lowest average boiler pressure was 176.9 lbs., while the highest was 203.4 lbs. In general, however, the variations of average pressure did not exceed 5 per cent. The temperature of the feed water was very uniform. In the majority of tests more than 150 lbs. of coal per square foot of grate were fired. Only two of the tests fell below 100 lbs. The total coal fired per square foot of grate area follows:

In 3 tests	between 100 and 150 lbs.
In 2 tests	between 150 and 200 lbs.
In 4 tests	between 200 and 250 lbs.
In 1 test	more than 250 lbs.

Evaporation.—Table 2.

The evaporation per hour was between the limits of 10,828 lbs. and 25,860 lbs.

The quality of steam in the steam dome was obtained by means of a throttling calorimeter and it is of interest to note that it was uniformly high, the moisture never exceeding 1¼ per cent. By glancing down the column, however, it will be seen that there was a slight tendency for the moisture to increase as the rate of evaporation increased.

The quality of steam in the branch pipe at a point close to the steam chest was, of course, dependent somewhat on cylinder con-

ditions and particularly on the position of the throttle valve. The superheat of 19.74 deg. in the branch pipe in test No. 101 was due to the fact that the throttle was only partly open.

The equivalent evaporation per hour from and at 212 deg. Fahr. is an accurate measure of the work done by the boiler and gives a convenient unit for making comparisons.

Boiler Power.—Table 3.

The equivalent pounds of water evaporated per square foot of grate surface per hour ranged from 262 to 625.

The equivalent evaporation per square foot of heating surface ranged from 5.18 to 12.39 lbs. per hour.

The maximum boiler horse-power developed was 891.3, the horse-power being calculated on the usual basis of 34.5 evaporative units per horse-power.

The horse-power developed per square foot of heating surface ranged from .150 to .359.

The maximum horse-power developed per square foot of grate surface is equivalent to about 1 h.p. for each .055 sq. ft. of grate surface.

Coal and Rate of Combustion.—Table 4.

When large quantities of coal are consumed the error introduced by a variation in the condition and thickness of the fire at the beginning and at the end of a test is less important than in tests where smaller quantities are used, but great care was exercised

TABLE 1—GENERAL BOILER CONDITIONS.

Identification of Test		Duration of Test, Minutes	Average Pressure Lbs. Per Sq. Inch		Average Temperature, Degrees Fahr.		Total Coal Fired Per Sq. Ft. of Grate Lbs.
Test Number	Laboratory Designation		Boiler Pressure	Atmospheric Pressure	Of Laboratory	Of Feed Water	
		Cal.	217	221	208	211	Cal.
110	40–20–F	150	200.4	14.50	75.9	73.9	57.2
111	40–30–F	180	203.4	14.46	72.5	73.8	84.3
109	80–20–F	200	191.6	14.37	70.7	67.1	143 3
103	80–20–F	180	197.6	14.41	78.3	63.7	129.4
112	80–30–F	180	200.7	14.45	74.1	74.0	170.5
102	160–20–F	210	189.3	14.49	71.1	67.4	234.6
105	160–27–F	180	181.6	14.55	70.3	70.9	235.3
116	120–30–F	180	198.7	14.50	73.6	73.0	216.3
118	80–37–F	180	201.4	14.51	82.2	74.2	212.7
101	160–40–P	180	176.9	14.50	73.5	72.5	261.7
115	120–35–F	180	193.1	14.44	78.1	73.4	248.9
117	160–35–P	130	201.8	14.48	78.6	73.5	184.9

TABLE 2—EVAPORATION.

Identification of Test		Duration of Test, Minutes	Water and Steam		Calorimeter Results			Equivalent Evaporation Lbs. Per Hour
Test Number	Laboratory Designation		Total Lbs. Evaporated	Lbs. Evaporated Per Hour	Quality of steam in Dome	Quality of steam in Branch Pipe	Degrees Superheat in Branch Pipe	
		Cal.	264	340	228	229	230	344
110	40–20–F	150	27071	10828	.9884	.9964	0	12870
111	40–30–F	180	38744	12915	.9903	.9918	0	15372
109	80–20–F	200	51219	15381	.9882	——	——	18375
103	80–20–F	180	51586	17195	.9889	.9927	0	20581
112	80–30–F	180	57620	19207	.9886	.9924	0	22825
102	160–20–F	210	51546	20442	.9887	.9972	0	24410
105	160–27–F	180	69344	23114	.9894	.9977	0	27513
116	120–30–F	180	70355	23452	.9882	.9913	0	27856
118	80–37–F	180	70969	23656	.9883	.9953	0	28102
101	160–40–P	180	71355	23785	.9899	1.0109	19.74	28203
115	120–35–F	180	75575	25192	.9885	.9917	0	29900
117	160–35–P	130	56115	25860	.9877	.9858	0	30747

TABLE 3—BOILER POWER.

Identification of Test		Duration of Test, Minutes	Equivalent Evaporation, Lbs.		Boiler Horse Power		
Test Number	Laboratory Designation		Per Sq. Ft. of Grate Surface Per Hour	Per Sq. Ft. of Heat'g Surface Per Hour	Total	Per Sq. Ft. of Heating Surface	Per Sq. Ft. of Grate Surface
		Cal.	Cal.	345	349	Cal.	Cal.
110	40–20–F	150	262	5 18	373.0	.150	7.58
111	40–30–F	180	312	6.19	445.5	.179	9.05
109	80–20–F	200	373	7.40	532.6	.215	10.82
103	80–20–F	180	418	8.29	596.5	.240	12.12
112	80–30–F	180	464	9.20	661.6	.267	13.44
102	160–20–F	210	496	9.83	707.5	.285	14.38
105	160–27–F	180	559	11.08	797.5	.321	16.21
116	120–30–F	180	566	11.22	807.4	.325	16.41
118	80–37–F	180	571	11.32	814.6	.328	16.55
101	160–40–P	180	573	11.36	817.5	.329	16.61
115	120–35–F	180	608	12.04	866.7	.349	17.61
117	160–35–P	130	625	12.39	891.3	.359	18.12

TABLE 4—COAL AND RATE OF COMBUSTION.

Identification of Test		Duration of Test, Minutes	Total Dry Coal Fired	Fuel in Pounds			Rate of Combustion	
Test Number	Laboratory Designation			Total Combustible by Analysis	Dry Coal Fired Per Hour	Combustible Fired Per Hour	Dry Coal Per Sq. Ft of Grate Per Hour	Dry Coal Per Sq. ft. of Heating Surface Per Hour
		Cal.	235	236	338	Cal.	339	Cal.
110	40–20–F	150	2790	2590	1116	1036	22.7	.450
111	40–30–F	180	4104	3808	1368	1269	27.8	.551
109	80–20–F	200	6980	6186	2094	1858	42.6	.844
103	80–20–F	180	6268	5818	2089	1939	42.4	.842
112	80–30–F	180	8301	7779	2767	2593	56.2	1.115
102	160–20–F	210	11450	10148	3271	2899	66.5	1.318
105	160–27–F	180	11486	10701	3829	3567	77.8	1.543
116	120–30–F	180	10547	9340	3516	3113	71.5	1.416
118	80–37–F	180	10344	9576	3448	3192	70.1	1.389
101	160–40–P	180	12755	11901	4252	3967	86.4	1.713
115	120–35–F	180	12122	11233	4041	3744	82.1	1.628
117	160–35–P	130	9021	8326	4163	3842	84.6	1.677

TABLE 5—CINDERS AND SPARKS.

Identification of Test		Duration of Test, Minutes	Total in Lbs. Per Hour			Calorific Value, B.T.U. Per Lb.	
Test Number	Laboratory Designation		Cinders in Smoke-Box	Sparks from Stack	Cinders and Sparks	Of Cinders	Of Sparks
		Cal.	Cal.	Cal.	Cal.	250	251
110	40–20–F	150	74.0	34.0	108.0	11004	7483
111	40–30–F	180	44.3	24.0	68.3	8363	7263
109	80–20–F	200	10.1	29.7	39.8	——	——
103	80–20–F	180	40.0	38.3	78.3	——	——
112	80–30–F	180	204.0	39.6	243.6	10564	7923
102	160–20–F	210	278.0	81.7	359.7	11158	8772
105	160–27–F	180	362.6	156.0	518.6	10454	8584
116	120–30–F	180	407.0	105.0	512.0	10684	8033
118	80–37–F	180	255.0	64.0	319.0	11005	9024
101	160–40–P	180	424.0	227.0	651.0	9464	7813
115	120–35–F	180	482.3	127.3	609.6	10784	7923
117	160–35–P	130	385.3	107.0	492.3	11224	9024

TABLE 6—DRAFT, RATE OF COMBUSTION, SMOKE-BOX AND FIRE-BOX TEMPERATURES.

Identification of Test		Duration of Test, Minutes	Draft in inches of Water				Temperature Degrees Fahrenheit		Dry Coal Per Sq. Ft. of Grate Surface Per Hour Pounds
Test Number	Laboratory Designation		In front of Diaphragm	Back of Diaphragm	In Fire-Box	In Ash-Pan	In Fire-Box	In Smoke-Box	
		Cal.	222	223	224	225	212	207	339
110	40–20–F	150	——	1.05	.70	.56	1427	561	22.7
111	40–30–F	180	——	1.36	.945	.51	1480	581	27.8
109	80–20–F	200	——	1.70	.676	.59	1658	565	42.6
103	80–20–F	180	2.08	1.63	1.369	1.03	1662	562	42.4
112	80–30–F	180	2.50	2.46	1.910	1.03	1742	656	56.2
102	160–20–F	210	2.94	2.74	1.706	1.03	2028	654	66.5
105	160–27–F	180	3.59	3.38	1.860	1.03	2112	691	77.8
116	120–30–F	180	3.70	3.28	2.036	1.00	1769	722	71.5
118	80–37–F	180	3.60	3.10	1.284	1.13	1766	685	70.1
101	160–40–P	180	4.21	3.76	1.145	.91	1968	714	86.4
115	120–35–F	180	4.66	3.81	2.415	1.69	2001	724	82.1
117	160–35–P	130	4.25	3.62	2.173	1.09	1821	726	84.6

in all cases to eliminate, as far as possible, this source of error. The total coal fired ranged from 2,790 lbs. to 12,755 lbs., and the amount per hour from 1,116 lbs. to 4,252 lbs.

The dry coal fired per sq. ft. of grate area per hour ranged from 22.7 lbs. to 86.4 lbs., showing the intensity of the furnace action. By glancing down the column it will be noted that the increase in the rate of combustion was not regular.

The coal burned per square foot of heating surface per hour ranged from .450 to 1.713 lbs.

Cinders and Sparks.—Table 5.

This table is significant only in a general way, as it was found that a good many sparks escaped from the spark trap and were carried away.

The maximum calorific value of the cinders was 11,244 B.t.u., and the maximum calorific value of the sparks was 9.024 B.t.u.

Draft, Rate of Combustion, Smoke-box and Firebox Temperatures.—Table 6.

In Fig. 1 are plotted the draft pressures as shown in Table 6. The ordinates represent draft, while the abscissæ represent rates of combustion. The straight lines which have been drawn do not represent absolutely the draft pressures which were observed, but the lines are approximately correct. They are given principally to show the relative amount of draft required to overcome

TABLE 7—EVAPORATIVE PERFORMANCE.

Identification of Test		Duration of Test, Minutes	Evaporative Performance				
Test Number	Laboratory Designation		Total Water Divided by Total Coal	Equivalent Evaporation Per Lb. of Dry Coal	Equivalent Evaporation Per Lb. of Combustible	B. T. U. Per Lb. of Dry Coal	Efficiency of Boiler
		Cal.	Cal.	347	348	248	350
110	40-20-F	150	9.61	11 53	12.42	14109	78.93
111	40-30-F	180	9.34	11.24	12.11	14013	77.45
109	80-20-F	200	7.28	8.78	9.90	13482	59.92
103	80-20-F	180	8.10	9.85	10.61	14144	67.25
112	80-30-F	180	6.87	8.25	8.80	14242	55.94
102	160-20-F	210	6.19	7.46	8.42	13482	48.40
105	160-27-F	180	5.98	7.19	7.71	14755	47.04
116	120-30-F	180	6.61	7.92	8.95	13769	55.57
118	80-37-F	180	6.78	8.15	8.80	14809	53.15
101	160-40-P	180	5.54	6.63	7.11	14119	45.37
115	120-35-F	180	6.17	7.40	7.99	14124	50.59
117	160-35-P	130	6.17	7.39	8.00	14651	48.69

TABLE 8—SMOKE-BOX GASES.

Identification of Test		Duration of Test, Minutes	Analysis of Smoke-Box Gases				Calorific Value of Coal as Fired	Per Cent. of Heat in Coal, Lost by Presence of CO
Test Number	Laboratory Designation		Per Cent. Oxygen O	Per Cent. Carbon Monoxide CO	Per Cent. Carbon Dioxide CO_2	Per Cent. Nitrogen N		
		Cal.	253	254	255	256	Cal.	Cal.
110	40-20-F	150	7.40	07	11.70	80.83	13976	.36
111	40-30-F	180	5.96	07	12.90	81.07	13866	.33
109	80-20-F	200	6.00	1 08	11.97	80.95	13315	5.31
103	80-20-F	180	5.38	1.40	12.15	81.07	13920	6.34
112	80-30-F	180	3.33	2.57	12.40	81.70	14086	10.42
102	160-20-F	210	4.44	1.13	13.03	81.40	13315	5.12
105	160-27-F	180	5.07	1.63	11.73	81.57	14636	7.12
116	120-30-F	180	3.67	3.30	12.23	80.80	13646	13.31
118	80-37-F	180	3.60	4.13	11.70	80.57	14636	15.23
101	160-40-P	180	3.17	2.93	11.67	82.23	13976	12.27
115	120-35-F	180	2.20	4.53	12.43	80.84	13976	16.33
117	160-35-P	130	6 90	2.25	9.75	81.10	14526	11.03

TABLE 9—GENERAL ENGINE CONDITIONS.

Identification of Test		Duration of Test, Minutes	Revolutions Per Minute	Speed in Miles Per Hour	Cut-off, Per Cent. of Stroke	Steam Pressure	
Test Number	Laboratory Designation					In Boiler Lbs. Per Sq. In.	In Branch-Pipe Lbs. Per Sq. In.
		Cal.	198	199	268 to 271	217	220
110	40-20-F	150	40.33	6.70	22.44	200.4	——
111	40-30-F	180	40.42	6.72	30.45	203.4	202.4
103	80-20-F	180	92.74	15.40	22.80	197.6	197.3
109	80-20-F	200	81.59	13.55	20.88	191.6	——
112	80-30-F	180	79.73	13.24	29.24	200.7	199.6
118	80-37-F	180	80.69	13.40	39.34	201.4	194.6
116	120-30-F	180	120.12	19.95	31.33	198.7	195.7
115	120-35-F	180	120.63	20.04	33.96	193.1	188.2
102	160-20-F	210	160.33	26.63	22.16	189.3	187.4
105	160-27-F	180	157.64	26.20	28.03	181.6	169.4
117	160-35-P	130	160.63	26.68	35.30	201.8	165.4
101	160-40-P	180	160.50	26.66	42.14	176.9	110.9

TABLE 10—MEAN EFFECTIVE PRESSURE, INDICATED HORSE POWER AND STEAM CONSUMPTION.

Identification of Test		Duration of Test, Minutes	Mean Effective Pressure Lbs. Per Sq. Inch	Indicated Horse Power	Dry Steam Per Indicated Horse Power Hour, Lbs.
Test Number	Laboratory Designation				
		Cal.	Cal.	379	381
110	40-20-F	150	85.76	365.7	28.33
111	40-30-F	180	106.34	454.5	27.29
103	80-20-F	180	66.33	650 0	25.51
109	80-20-F	200	68.12	587.6	25.31
112	80-30-F	180	92.42	779.3	23.92
118	80-37-F	180	108.99	930.5	24.70
116	120-30-F	180	76.75	975.1	23.43
115	120-35-F	180	81.22	1036.1	23.74
102	160-20-F	210	47.36	803,3	24.78
105	160-27-F	180	57.09	951.4	23.7?
117	160-35-P	130	60.27	1023.7	24.69
101	160-40-P	180	50.23	851.7	27.30

TABLE 11—DYNAMOMETER RECORDS.

Identification of Test		Duration of Test, Minutes	Draw-Bar Pull in Pounds	Dynamometer Horse Power	Dry Coal, Per D. H. P. Hour	Dry Steam Per D. H. P. Hour
Test Number	Laboratory Designation					
		Cal.	205	383	384	385
110	40-20-F	150	15706	280.6	3.84	36.91
111	40-30-F	180	20864	373.5	3.54	33.21
103	80-20-F	180	12587	517.0	3.93	32.07
109	80-20-F	200	13314	481.2	4.24	30.88
112	80-30-F	180	17831	629.8	4.30	29.59
118	80-37-F	180	22078	789.2	4.28	26.14
116	120-30-F	180	14813	788.1	4.38	28.99
115	120-35-F	180	15883	848.6	4.69	28.98
102	160-20-F	210	8666	615.5	5.22	32.34
105	160-27-F	180	9929	693.5	5.43	32.55
117	160-35-P	130	10902	775.7	5.28	32.58
101	160-40-P	180	9118	648.3	6.48	35.87

TABLE 12—MACHINE FRICTION.

Identification of Test		Duration of Test, Minutes	Machine Friction in			Machine Efficiency Per Cent.
Test Number	Laboratory Designation		Horse Power	Mean Effective Pressure Lbs. Per Sq. In	Draw-Bar Pull Pounds	
		Cal.	395	396	397	398
110	40–20–F	150	85.1	19.97	4764	76.74
111	40–30–F	180	81.0	18.97	4524	82.18
	Average		**83.1**	**19.47**	**4644**	
103	80–20–F	180	133.0	13.57	3237	79.54
109	80–20–F	200	106.4	12.35	2944	81.90
112	80–30–F	180	149.5	17.74	4233	80.82
118	80–37–F	180	141.3	16.57	3953	84.82
	Average		**132.5**	**15.06**	**3591**	
116	120–30–F	180	187.0	14.74	3513	80.82
115	120–35–F	180	187.5	14.70	3509	81.91
	Average		**187.2**	**14.72**	**3511**	
102	160–20–F	210	187.8	11.09	2644	76.63
105	160–27–F	180	257.9	15.48	3693	72.89
117	160–35–P	130	248.0	14.61	3485	75.78
101	160–40–P	180	203.4	11.99	2860	76.12
	Average		**224.2**	**13.29**	**3171**	

the several resistances encountered by the air in its passage from the ash-pan to the smoke-box. The air openings in the ash-pan of this locomotive were rather small, as indicated by the relatively high reduction of pressure in the ash-pan.

If G represents the rate of combustion in pounds per square foot of grate surface per hour and D represents the draft in front of the diaphragm in the smoke-box, then for this locomotive, as shown by the upper line of Fig. 1:

$$D = .049G \quad \ldots\ldots (1)$$

This approximate equation means that for every pound of coal burned per square foot of grate per hour, a draft of .049 in. of water is required in the smoke-box. This equation may be of value in comparing the draft of other locomotives to be considered in future bulletins.

The temperatures in the firebox and in the smoke-box were obtained by means of a Le Chatelier pyrometer. Smoke-box temperatures were also obtained by means of a thermometer, both instruments checking closely.

For ease in comparison, Fig. 2 has been plotted, which shows firebox and smoke-box temperatures on the same diagram, the abscissæ being rates of combustion in pounds per square foot of grate per hour.

The firebox temperatures ranged from 1,427 to 2,112 deg. Fahr. and the smoke-box temperatures ranged from 561 to 726 deg. Fahr.

The diagram, Fig. 2, shows that the firebox temperature increased at a much greater

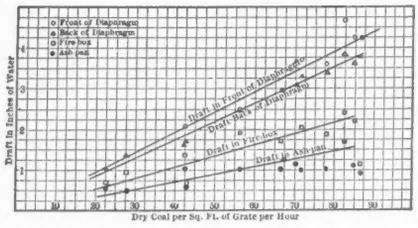


Fig. 1—Draft and Rate of Combustion.

rate then the smoke-box temperature as the rate of combustion increased. In fact, the variations in smoke-box temperatures were within comparatively small limits. The length of the ordinate, such as A B, between the two lines on the diagram at any given rate of combustion, represents the degrees of heat lost by the gases in passing from the firebox to the smoke-box. This heat has been absorbed by the heating surface of the boiler and should bear some relation to the rate of evaporation. The relation which exists is determined as follows:

Let;

H = Equivalent rate of evaporation in pounds per square foot of heating surface per hour.

G = Rate of combustion in pounds per square foot of grate per hour.

T_f = Temperature in firebox in deg. Fahr.

T_s = Temperature in smoke-box in deg. Fahr.

Then $T_f - T_s$ represents the drop in temperature of the gases in passing from the firebox to the smoke-box.

From Fig. 2 the relation between T_f and G is found to be for this locomotive:

$$T_f = 9.6\ G + 1{,}210 \quad \ldots\ldots (2)$$

Similarly, the relation between T and G is found to be

$$T_s = 2.44\ G + 500 \quad \ldots\ldots (3)$$

Then the drop in temperature is determined by subtracting (3) from (2) which gives

$$T_f - T_s = 7.16\ G + 710 \quad \ldots\ldots (4)$$

The relation existing between G and H is plotted in Fig. 3, from which

$$H = .113\ G + 2.9 \quad \ldots\ldots (5)$$

From equation (4)

$$G = \frac{T_f - T_s}{7.16} - 99.1 \quad \ldots\ldots (6)$$

From equation (5)

$$G = \frac{H}{.113} - 25.7 \quad \ldots\ldots (7)$$

Equating equations (6) and (7) and reducing gives:

$$H = \frac{T_f - T_s}{63.4} - 8.29 \quad \ldots\ldots (8)$$

By the use of equation (8) the rate of evaporation can be determined if the tem-

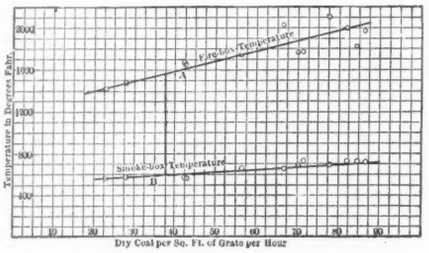


Fig. 2—Fire-box and Smoke-box Temperatures.

peratures of the firebox and smoke-box are known. Similarly, the rate of combustion can be found from equation (5) if the rate of evaporation is known, or vice versa.

Evaporative Performance.—Table 7.

The equivalent evaporation per pound of dry coal ranged from 11.53 lbs. to 6.63 lbs.

The heating value of the coal was practically uniform for all the tests.

The efficiency of the boiler dropped rapidly as the rate of evaporation increased, the range being between the rather wide limits of 78.93 per cent. and 45.37 per cent.

For the purpose of obtaining an equation between rate of evaporation and evaporation per pound of dry coal, Fig. 4 has been plotted. The connection between the rate of evaporation per square foot of heating surface per hour, H, and the rate of combustion in pounds per square foot of grate per hour, G, has already been determined, so that if G is known, the equivalent pounds of water evaporated per pound of dry coal, E, can be de-

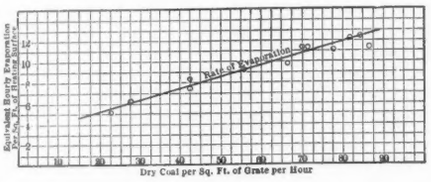


Fig. 3—Rate of Combustion and Rate of Evaporation.

termined from the following equation derived from Fig. 4:

$$E = 15 - .66\ H \quad \ldots\ldots (9)$$

While all the equations which have been derived do not represent every experimental result which has been obtained, they will, nevertheless, serve as a convenient and logical basis upon which comparisons can be made.

Smoke-Box Gases.—Table 8.

While the percentage of oxygen showed some irregularities, nevertheless there was a tendency for it to decrease as the rate of evaporation increased—the range for the several tests being between the limits of 7.40 per cent. and 2.20 per cent.

The percentage of CO increased as the rate of evaporation increased—the range for this locomotive being between the limits of .07 per cent. and 4.53 per cent.

The carbon dioxide, CO_2, ranged from 9.75 per cent. to 13.03 per cent.

The calorific value of the coal as fired is of interest chiefly in connection with the last column of Table 8, which gives the per cent. of heat lost by imperfect combustion due to the fact that part of the carbon is burned to CO instead of CO_2. The method of determining the items in this column is as follows:

Let A = per cent. of CO in smoke-box gases.

B = per cent. of CO_2 in smoke-box gases.

C = per cent. of carbon in fuel (determined by an ultimate analysis to be 84.20 per cent.).

D = calorific value of fuel as fired in B.t.u.

10,150 = B.t.u. lost in burning 1 lb. of carbon to CO instead of CO_2.

P = per cent. of heat lost in coal as fired due to presence of CO.

then

$$\frac{\left\{\frac{A}{A+B}\right\} \times C \times 10{,}150}{D} = P \quad \ldots\ldots (10)$$

The heat lost by imperfect combustion ranged from .333 per cent. to 16.35 per cent.

PERFORMANCE OF ENGINES.

The results in Tables 9 and 10 are arranged

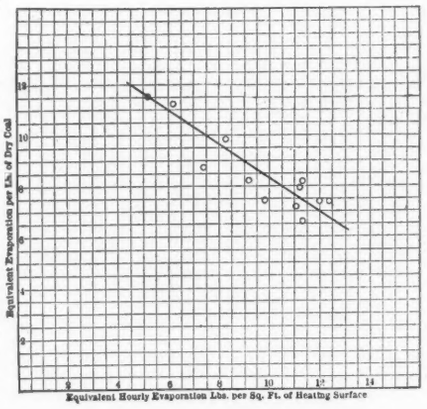


Fig. 4—Rate of Evaporation and Evaporation per Lb. of Coal.

with reference to the speed of the locomotive, the tests at each speed being grouped. The tests in each group are arranged with reference to the nominal cut-off in the cylinders, the first test in each group being at the shortest cut-off and the last test being at the longest cut-off.

General Engine Conditions.—Table 9.

This table is self-explanatory. The actual revolutions per minute approximated closely to those selected for each test. The actual per cent. of cut-off varied somewhat from the nominal, but was as close as could be obtained with the spacing of the notches on the reverse lever quadrant.

The lowest speed at which any test was run was 6.7 miles an hour, while the highest speed was 26.68 miles per hour.

Mean Effective Pressure, Indicated Horse-Power and Steam Consumption.—Table 10.

The significance of the mean effective pressure, the total indicated horse-power and the steam consumption, respectively, for the several cut-offs and speeds is best shown by reference to Figs. 5, 6 and 7. In these diagrams the horizontal scale represents the cut-off in per cent. of stroke, while the vertical scale gives the speed of the locomotive in revolu-

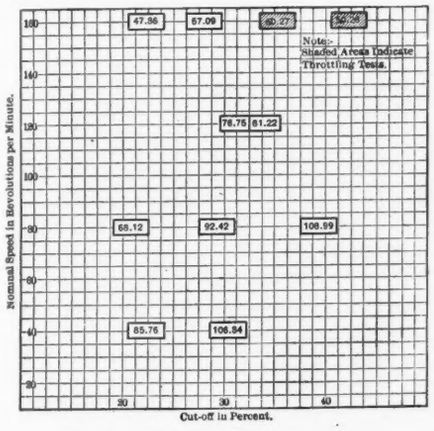


Fig. 5—Mean Effective Pressure.

tions per minute. The effect of cut-off and speed on mean effective pressure is shown by Fig. 5. Comparisons along horizontal lines show the effect of increasing the cut-off at constant speed, as for example, at 80 r.p.m., at which speed the mean effective pressure was 68.12 lbs., 92.42 lbs. and 108.99 lbs. at approximately 20, 30 and 40 per cent. cut-off respectively. Comparisons along vertical lines show the effect of changes in speed when the cut-off was nearly constant. For example, at a nominal cut-off of 30 per cent. the mean effective pressure was 106.34, 92.42, 76.75 and 57.09 lbs. at 40, 80, 120 and 160 r.p.m. respectively.

The relations between steam consumption, speed and cut-off are shown in Fig. 6. The best performance of the engine was at 31⅓ per cent. cut-off and 120.12 r.p.m. (about 20 miles per hour), under which conditions the steam consumption was 23.43 lbs. per i.h.p. hour. It is noticeable that at full throttle tests the differences in steam per indicated horse-power hour were small.

The diagram, Fig. 7, shows the relation between indicated horse-power, speed and cut-off. The highest indicated horse-power was 1,036, which was obtained at 35 per cent. nominal cut-off and a nominal speed of 120 r.p.m.

PERFORMANCE OF LOCOMOTIVE.

Dynamometer Records.—Table 11.

The performance of a locomotive, taken as a unit, is best measured in terms of drawbar pull or dynamometer horse-power, as these factors determine the usefulness of the machine for hauling cars.

The maximum average recorded drawbar pull was 22,078 lbs. at a nominal speed of 80 r.p.m. and a nominal cut-off of 37 per cent. Higher drawbar pulls were not obtained because, at slow speeds and long cut-offs there was constant danger of stalling the brakes and slipping the drivers owing to the fluctuations of the pressure of the water used for controlling the brakes.

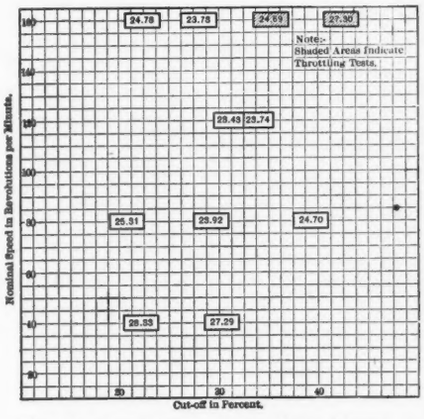


Fig. 6—Dry Steam per I. H. P. Hour.

The maximum dynamometer horse-power was 848.6, which was obtained at a nominal speed of 120 r.p.m. and a nominal cut-off of 35 per cent.

The general tendency is for the coal per dynamometer horse-power hour to increase as the speed increases. The minimum coal rate obtained was 3.54 lbs. and the maximum rate was 6.48 lbs. per horse-power hour.

The lowest steam consumption was 26.14 lbs. per dynamometer horse-power hour, which was obtained at a nominal speed of 80 r.p.m. and a nominal cut-off of 37 per cent.

Machine Friction.—Table 12.

The friction of the mechanism of the locomotive is given in terms of horse-power, mean effective pressure and drawbar pull respectively. At a given speed, the general law governing the variation of these factors is not apparent. In fact, the machine friction appears to be a constant for any given speed, and for this reason the average value of these items has been worked out for each speed.

The average value of the frictional horse-power for nominal speeds of 40, 80, 120 and 160 r.p.m. was 83.1, 132.5, 187.2 and 224.2 respectively. The average value of the frictional mean effective pressure at nominal speeds of 40, 80, 120, 160 r.p.m. was 19.47, 15.06, 14.72 and 13.29 lbs. respectively. The average frictional drawbar pull was 4,644, 3,591, 3,511 and 3,171 lbs. at nominal speeds of 40, 80, 120 and 160 r.p.m., respectively. These figures disclose the fact that the frictional mean effective pressure and frictional drawbar pull decrease as the speed increases, which is consistent with the general laws of friction.

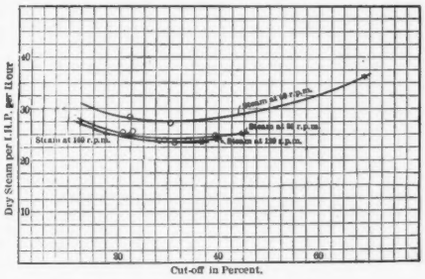


Fig. 8—Steam Consumption.

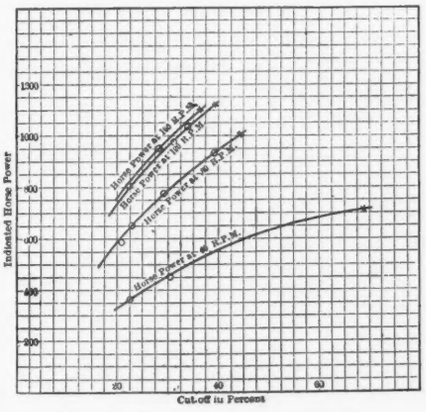


Fig. 9—Indicated Horse Power.

The machine efficiency ranged from 72.89 per cent. to 84.82 per cent. In view of the fact that the frictional horse-power, frictional mean effective pressure and frictional drawbar pull are each practically constant for a given speed, it follows that the machine efficiency at a given speed should be expected to increase as the cut-off increases. The results are, in general, consistent with this assumption. For example, at a nominal speed of 40 r.p.m. and a nominal cut-off of 20 per cent., the machine efficiency was 76.74 per cent. At the same speed, but with a nominal cut-off of 30 per cent., the machine efficiency was 82.18 per cent.

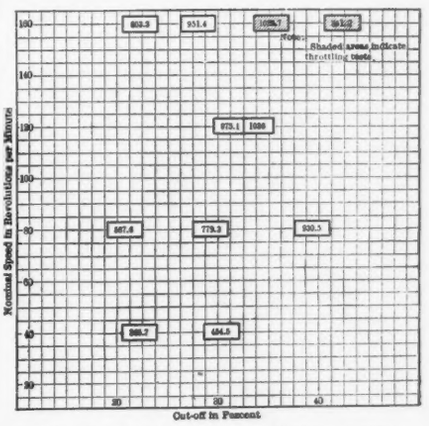


Fig. 7—Total Indicated Horse Power.

Maximum Power of Locomotive.

From what has already been said concerning the limitations affecting tests at high drawbar pulls and speeds, and also from an inspection of the recorded data, it is apparent that it is impossible to construct, directly for this locomotive, a diagram showing the maximum drawbar pull at all speeds. The importance of such information, however, seems to justify an attempt to construct such a diagram by using the data at hand to establish relations from which the performance of the locomotive can be reasonably determined for conditions beyond the limits of the tests.

In general, the maximum power of a locomotive depends on the relation between the amount of water which can be evaporated by the boiler and the efficiency of the cylinders. For example, if the maximum evaporative power of a locomotive boiler is W pounds of dry steam per hour and the cylinders require N pounds of dry steam per indicated horse-power hour, then the maximum indicated power of the locomotive is represented by $\frac{W}{N}$ except that the maximum power may be limited by the adhesion of the driving wheels.

The maximum evaporative power of the boiler, as disclosed by these tests, is between 25,000 and 26,000 lbs. of dry steam per hour, which is equivalent to a rate of evaporation of between 10 and 11 lbs. per square foot of heating surface per hour.

Fig. 8 shows the relation between steam consumption per indicated horse-power hour and cut-off at the several nominal speeds. Similarly, Fig. 9 shows the relation between indicated horse-power and cut-off at the several speeds. In each diagram the curves have been extended somewhat beyond the experimental points, but the error introduced thereby should not alter much the final results. It is now only necessary to select for each speed the cut-off at which the product of indicated horse-power, as shown by Fig. 9, and steam consumption, as shown by Fig. 8, is between 25,000 and 26,000 lbs. (the max-

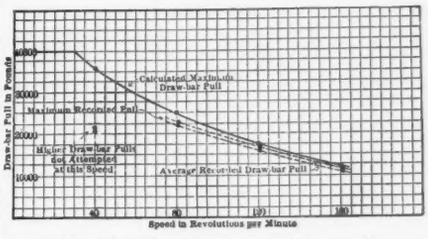


Fig. 10—Maximum Drawbar Pull.

imum capacity of the boiler). These critical cut-offs are indicated on the diagrams Figs. 8 and 9, with a cross mark, the values of the several factors being shown in the following table:

Nominal speed in r.p.m.	Cut-off in per cent.	Steam per I. H. P.-hour.	Maximum cylinder H. P.
40	69.0	36.2	715
80	44.5	25.1	1010
120	39.5	23.7	1120
160	36.5	23.2	1100

The cylinder horse-power given in the last column of the above table is what would be expected by indicator if tests had been run under the conditions of maximum power at the several speeds and cut-offs. It is now only necessary to reduce the cylinder horse-power to equivalent drawbar pull by means of the following equation, in which S is the speed in miles per hour and F is the corresponding average frictional drawbar pull (see Table 12):

$$\text{Drawbar pull} = \frac{\text{Horse power} \times 375}{\text{S}} - \text{F}$$

The drawbar pull at the several speeds, as determined from the above equation is given in the following table:

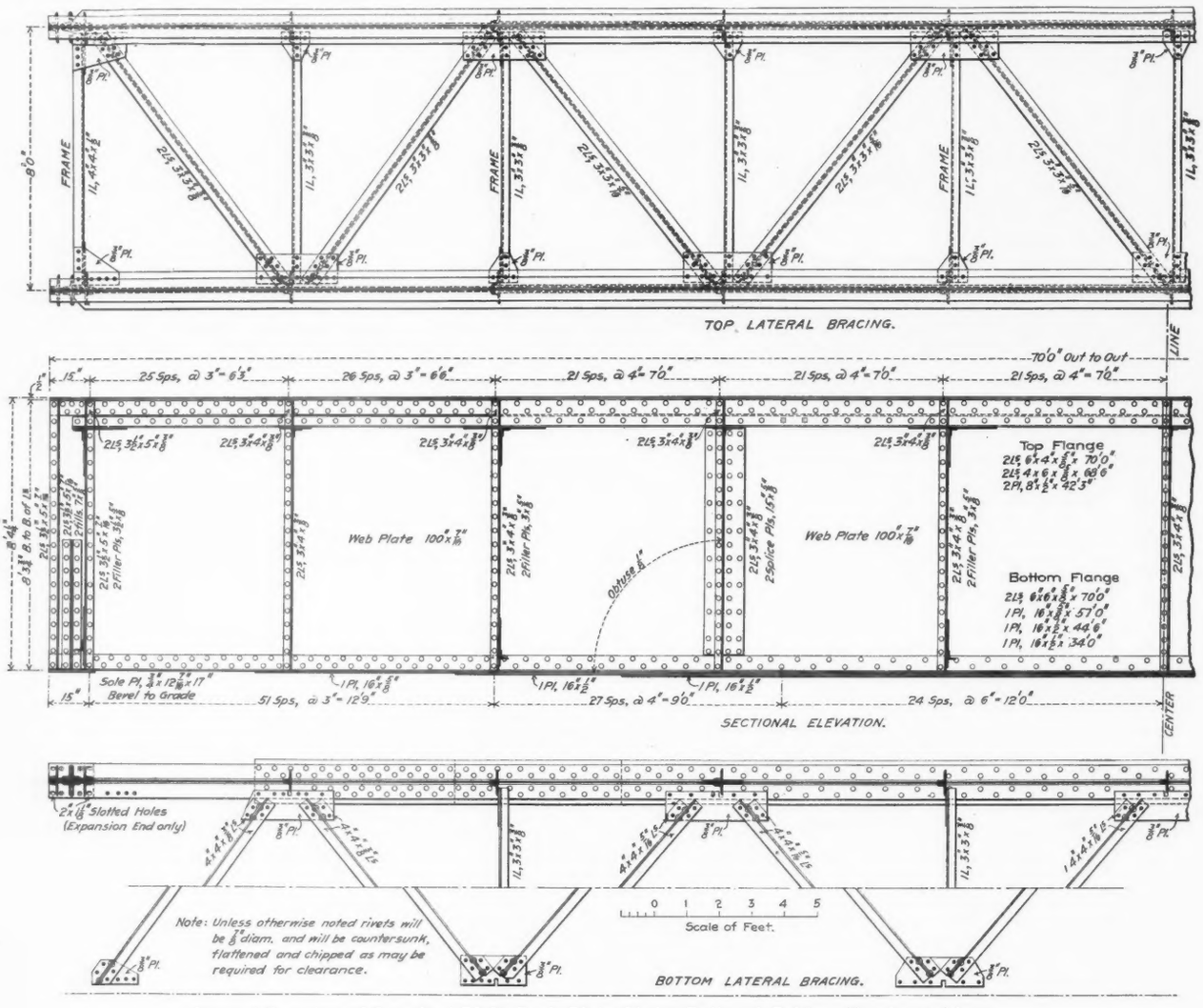
Speeds in r.p.m.	Maximum estimated drawbar pull, lbs.
40	35,706
80	24,903
120	17,554
160	12,346

The full line in the diagram, Fig. 10, shows graphically the results given in the above table. The lowest speed at which the full power of the boiler can be utilized is 30 r.p.m., this speed being determined by the intersection of the straight line of maximum tractive effort with the maximum power curve. The dotted lines on the diagram show the maximum and average drawbar pulls respectively, at the several speeds as actually recorded in the tests.

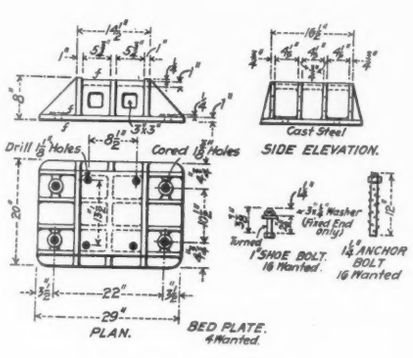
Standard Bridges on the Harriman Lines.*

The bridge shown in this issue is the standard 70-ft., deck plate girder, single-track span. It is 8 ft. 3¾ in. deep, back to back of flange angles, and weighs complete 68,000 lbs. In the 30, 40 and 50-ft. girders no camber was provided for, but in the 60-ft. girder shown last week, the two middle panels were given a camber by cutting the web plates at a slight obtuse angle. The third panels from each end in this girder are cut ⅛ in. obtuse to allow sufficient camber. The lateral and cross bracing is essentially the same as that shown last week for the 60-ft. girder. In the top flange of the 70-ft. girder there is a cross-sectional area of 34.94 sq. in. and in the bottom flange 42.85 sq. in.

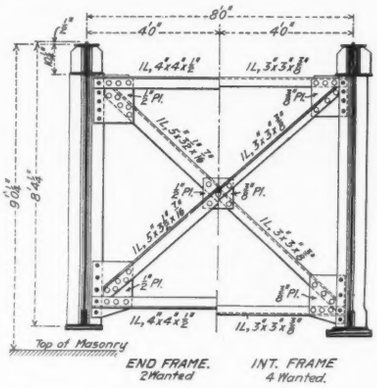
*Previous articles appeared in the *Railroad Gazette*, March 17, 24 and 31.



General Drawing of Standard 70-ft. Deck Plate Girder Railroad Bridge, Harriman Lines.



Details of Bed Plate.



Cross-Frames of 70-ft. Girder.

Another Accident in the New York Subway.

An accident occurred in the West Side branch of the Subway, near the 168th street station, on the morning of Wednesday, March 29, which did considerable damage to the tunnel and will delay the opening of the upper end of this branch for some weeks at least. Since the opening of the Subway last October, trains on the West Side branch have been running as far north as 145th street. The tunnel above that point is almost completed at the present time, and it was hoped to have the line in operation to the north end of the island before summer. Most of the excavation is finished, the tunnel lining is in place, and work on the stations was being pushed rapidly. Between the 157th street and Dyckman street stations the tunnel pierces solid rock and for most of the distance is from 125 ft. to 150 ft. below the surface, the two stations at 168th street and 181st street being reached by elevators going down through shafts.

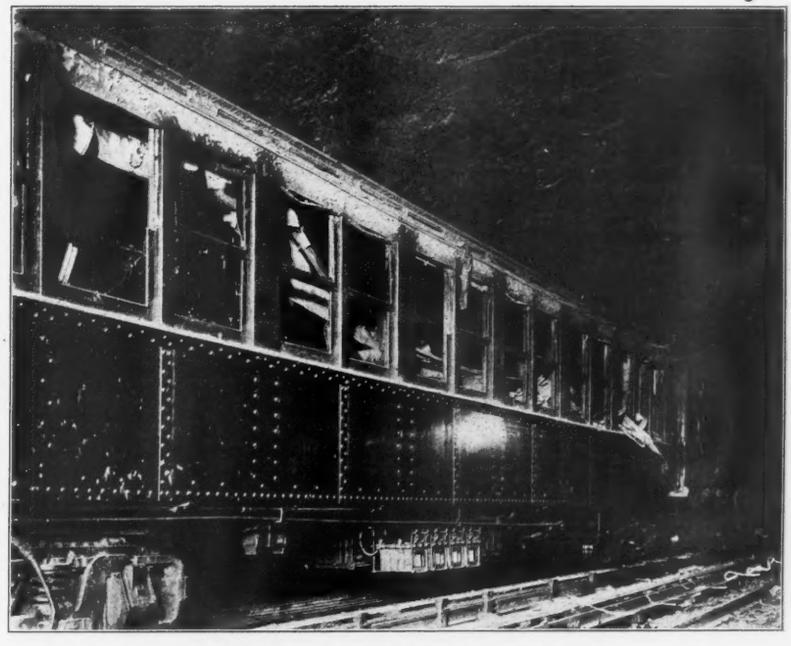
Ruins of Wooden Car—Next to Last Car in Train.*

At the time of the accident, the tunnel was entirely completed north to within about 100 ft. from the shaft at the 168th street station, and both tracks were laid, together with the third rails. On account of the congestion in the storage yard at the temporary terminal at 145th street, one track in this part of the tunnel was used for storing trains during the slack hours. On Wednesday morning a switching motorman employed at the terminal ran a train of seven cars north on this storage track, and when near the end of the track apparently lost his bearings and did not bring the train, which was moving at good speed, to a stop. The train consisted of a steel car at the head end, five copper sheathed wooden cars in the middle, and a steel car in the rear, and contained no passengers or employees other than the motorman. When it reached the end of the track, it left the rails, which were not protected with a bumper, and crashed through a wooden bulkhead, about 40 ft. beyond, which had been built in the tunnel to assist the ventilation up through the shaft at the 168th street station. Beyond the bulkhead piles of loose rock had been temporarily left by the contractors against each side of the tunnel and the steel car ran in between these for about 50 ft., stopping finally in a diagonal position across the tunnel, but remaining upright and on its trucks. The other cars were not splintered or badly wrecked and the motorman, who was not injured, made his way out through the train and back through the tunnel to the 157th street station.

There were a number of workmen in the tunnel beyond the bulkhead when the derailment occurred, and according to the statement of the foreman, the first car seemed to be on fire as it came through the bulkhead, due probably to the short circuiting of one of the collector shoes and the third rail. Fire broke out immediately afterward and forced the workmen out of the tunnel, some escaping by way of the shaft at 168th street, and some through the shaft at 181st street. The flames attacked the timbering in the uncompleted portion of the tunnel opposite the station and burned fiercely for more than 24 hours. Firemen poured streams down the shaft and succeeded in saving the timbering there, but it was impossible to reach the fire in the tunnel from either end on account of the intense heat and large volume of smoke. At the time it was said that the derailed train had collided with a hand-car loaded with dynamite which was used in blasting and numerous light explosions were felt soon after the fire broke out but the investigation made later showed no evidences of an explosion and no explosive was thought to have been in the tunnel at the time. There were, however, a number of barrels of cerion paint, a petroleum waterproofing compound, stored near the bulkhead, and these may have caused the light explosions felt.

The next day after the fire had burned itself out, exploring parties entered the tunnel at both ends and were able to reach the scene of the derailment which caused the fire. While one of the parties was advancing from the south end a portion of the roof fell and buried one fireman, killing him instantly. This was the only casualty.

The engineers who made an examination of the condition of the tunnel later found that the damage was confined to the roof and walls for a distance of about 300 ft. on each side of the station, and that the brick and stonework which had been completed in the station was totally ruined by the intense heat. Large masses of the concrete and brick tunnel lining had fallen down and portions of the rock above had been dislodged. All of the timbering was burned out in the tunnel but that in the shaft was not badly damaged. Some weeks will be required to clear out the fallen debris and replace the lining on each side of the station, and it may be six months before the station can be finished ready for use.

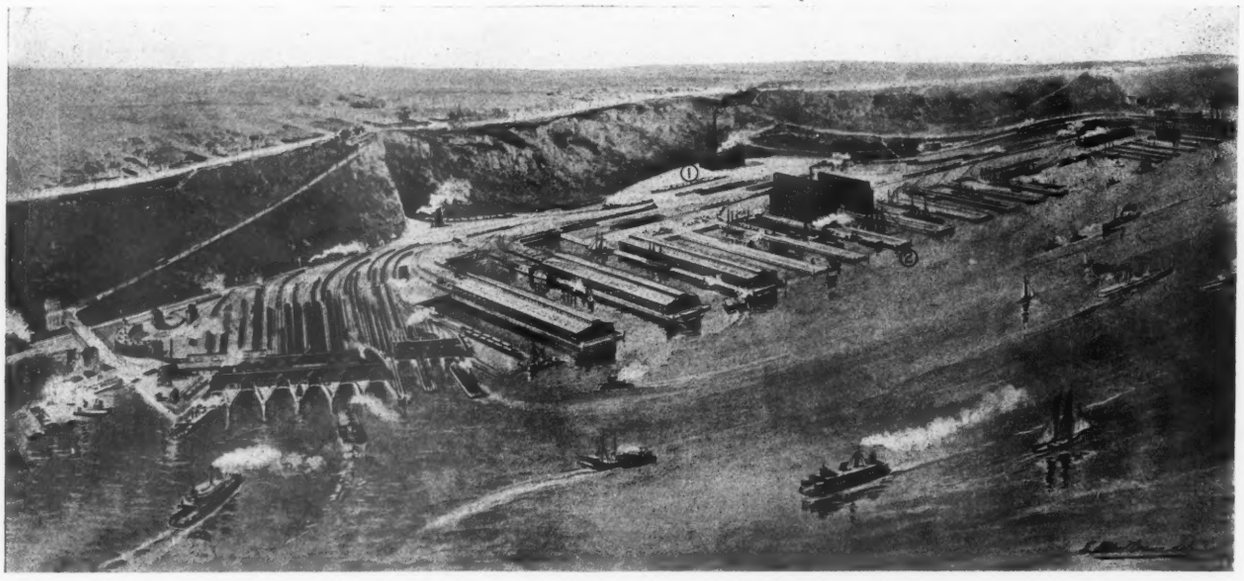


Steel Car Intact—Last Car in Train.*

Perhaps the most interesting and remarkable feature of the accident was the condition of the wrecked train after the fire. The five copper sheathed wooden cars were completely destroyed, nothing remaining of the bodies but a tangled and melted mass of

*Photos courtesy *New York World*.

iron. The trucks, being down below the worst of the fire, were not badly damaged. The two steel cars in the train, however, although subjected to a heat intense enough to melt the aluminum fittings in the interior, were not perceptibly damaged beyond having some of the plates warped and the paint burned off. The accompanying illustrations, which are from photographs taken for the New York *World* on the day after the accident, show clearly the condition of the two types of cars. The steel car was the last car in the train and the wooden car was next to it.



Bird's-Eye View of West Shore Terminals at Weehawken.

Large Grain Elevator at Weehawken.

BY J. C. IRWIN.

For many years the New York Central has had the largest grain elevator capacity of any railroad on New York Harbor. The elevator at the Sixtieth street yard, New York City, rebuilt in 1890, has a capacity of 1,500,000 bushels, and the West Shore elevator on Pier 8, at Weehawken, built in 1883, has a capacity of 1,200,000 bushels.

The completion of the new 2,000,000 bushel fireproof elevator on Pier 7, Weehawken, increases the New York Central elevator capacity 76 per cent., and gives this railroad a capacity of 4,700,000 bushels, which is greater than that controlled by all other railroads on the harbor combined. The main features of this new elevator are that it is absolutely fireproof, being built of brick, concrete and steel; it is available for use by deep draught vessels, having 32 ft. of water at mean low tide in the slips on both sides of the elevator; it is designed for quick handling and is operated entirely by electricity, furnished by a power station 1,000 ft. distant. It is fully equipped with dust collectors by which the dust is picked up by suction and disposed of outside of the building. Rope drives are used for the machinery to avoid electric sparks from the use of belts and the motors are all enclosed in dust-proof cases, to the interior of which fresh air is admitted through ducts from the exterior of the building.

The main building is 101 ft. 6 in. wide by 354 ft. 2 in. long and 200 ft. 8 in. high from the top of the foundation masonry to the ridge of the cupola roof. Two tracks pass through the building and the tail tracks extend on to the dock so that cars can be shoved through the building.

The grain is delivered from the cars into eight double-track hoppers, extending from the outside rail of each track to the foot of the elevator legs. The cars are unloaded by machine shovels guided by hand. After being dumped into the hoppers, the grain is elevated to the garners by means of continuous belt elevators, with sheet iron buckets extending from the bottom of the hoppers on the basement floor up to the top of the garners, which are located on the next to the top floor of the cupola. From the garners, 23 in number, the grain is delivered into the scale hoppers on the floor below, where it is weighed before being distributed into the various bins. There are also 23 scale hoppers, eight designed for receiving, each of which has a capacity of 2,000 bu., and 15 designed for shipping, transfer and cleaning, each of which has a capacity of 800 bu. From the scale hoppers the grain is delivered to a belt conveyor supplied with two trippers on the floor below, and by means of this conveyor it is distributed to a series of 40 trolley spouts, by means of which it can be delivered directly into any bin desired. The bins along the exterior are divided into two sets, vertically, the upper set being used for shipping bins for loading into boats, and the lower set being used for storage. The boots

New West Shore Grain Elevator at Weehawken. Capacity 2,000,000 Bushels.

on the exterior of the building connecting with the bottom of the shipping bins enable these bins to be emptied directly into the boats.

For the purpose of unloading boats into the elevator, a marine leg, enclosed in the steel tower, is provided near one end of the building. This delivers into the marine garner from which the grain can be delivered wherever desired. In order to transfer from one bin to another, there are eight cross belt conveyors under the first floor.

For cleaning the grain, 14 compound shake separators, each with a capacity of 5,500 bu. per hour, are provided.

A car puller, capable of handling 20 loaded cars, is arranged so that it can handle cars on either track.

In building this elevator, the foundations were particularly expensive, as the river mud and silt runs to a depth of from 75 to 110 ft. below mean low water, and under this is fine sand running to a depth of 88 to 114 ft. below mean low water before reaching hard sand bottom. It was found necessary to drive piles an average depth of 116 ft. The piles were spliced by the use of a dowel 1½ in. by 18 in. in the center of the butt joint and around the outside, six 3 in. x 6 in. white oak strips 16 ft. long, each secured by a 10-in. spike. The upper sections of the piles are from 60 to 75 ft. long, varying in length so that the splices will not come in the same horizontal plane.

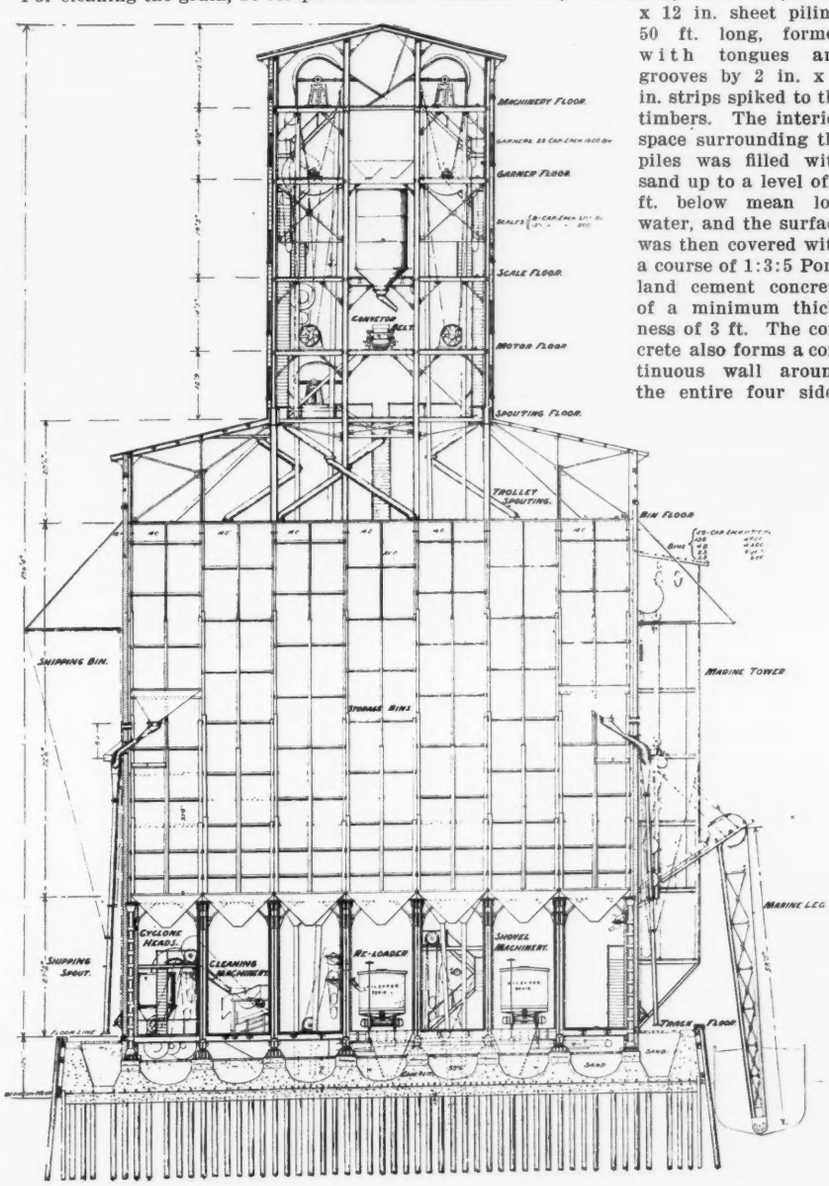
In building the foundation, a space about 126 ft. wide and 390 ft. long was dredged to a depth of 8 ft. below mean low water. The 3,842 piles forming the foundation were then driven and cut off at a uniform level of 3 in. below mean low water. The substructure, including the exterior concrete bulkhead wall, was entirely enclosed by 12 in. x 12 in. sheet piling, 50 ft. long, formed with tongues and grooves by 2 in. x 4 in. strips spiked to the timbers. The interior space surrounding the piles was filled with sand up to a level of 1 ft. below mean low water, and the surface was then covered with a course of 1:3:5 Portland cement concrete of a minimum thickness of 3 ft. The concrete also forms a continuous wall around the entire four sides of the pier. The piles supporting the rows of columns which form the steel structure are arranged with three rows of piles to each set of columns. Embedded in the concrete over the heads of the piles are two courses of steel rails, one running transversely and the other longitudinally, designed to distribute the load and take up any tensile stresses that may develop. The upper portion of the concrete bed is formed in inverted arches, brought up to the base of the column foundations, the interior space between the column foundations being filled with sand to support the concrete floor.

The main walls of the building are of North river brick laid in cement mortar to a height of 32 ft. above foundations, and above that point in lime mortar. The brick walls extend up to the tops of the bins and above that point the roofs of all the bins, the side walls of the cupola and the roof of the cupola are all constructed of tile, supported by the steel structure.

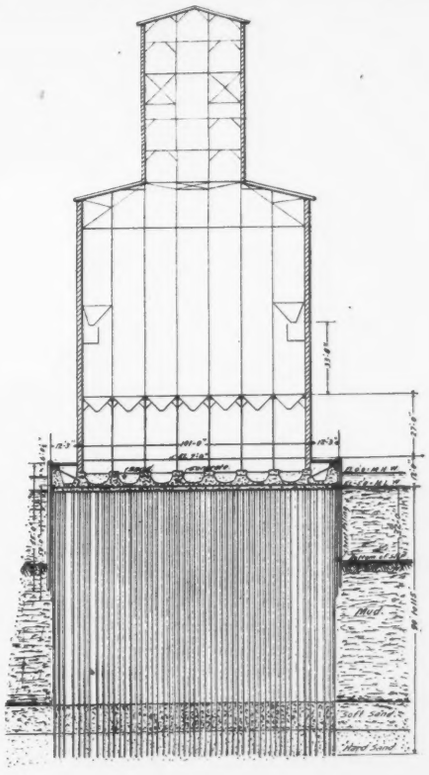
The interior steel frame of the building is made up of eight rows of 26 columns each, spaced 14 ft. centers. The middle four rows of columns are extended to the top of the cupola, which is 44 ft. 2 in. over all and 96 ft. high above the main eaves, and extends the full length of the building. Its walls are of 8-in. partition tile and it is divided into five stories, used for machinery, garners, scales, motors and distribution of the grain.

The floors, with the exception of the bin floor, are of concrete and expanded metal construction 4 in. thick, the lower portion consisting of 1:3:6 Portland cement concrete made with ¾ in. stone, and the top finish composed of 1:1 cement mortar.

The bin floor and also the roof over bins and cupola are of 3-in. book tile, laid on T irons, the bin floor tile being also covered with cement mortar. Over the book tile forming the roofs is laid a pitch and gravel roofing composed of five plies of No. 28 felt cemented together with American straight run coal tar pitch, coated with natural Trinidad asphalt covered with beach gravel.



Cross-Section Through Weehawken Elevator Showing Bins and Conveyor.



Foundations for Elevator.

The first floor columns and the exterior columns of the cupola are encased with 3 in. book tile, covered with cement mortar. The foremen's and weighmasters' offices and the switchboard room are partitioned off with 4-in. partition tile and have ceilings of 3-in. book tile.

The large doorways for cars are equipped with Kinnear patent steel doors, and all other doors and windows have fire doors of steel plate.

The building is completely piped for fire service and has 48 outlets, each equipped with hose on a swinging rack.

The bins are rectangular and are 72 ft. 6 in. deep from the top of their hopper bot-

toms to the bin floor. They are formed of steel plates 5 ft. deep of one piece for the entire width of the bin and the metal varies in thickness from $^5/_{16}$ in. in the lower courses to $^3/_{16}$ in. in the upper courses.

The bin capacity is made up as follows:

		Bushels.
59 regular bins	11,700 bush. each.	690,300
138 half-bins	5,850 " "	807,300
48 bins each side of legs	4,500 " "	216,000
23 under shipp'g bins.	4,900 " "	112,700
23 shipping bins	5,200 " "	119,600
		1,945,900

Including the capacity of garners and scale hoppers the total capacity is brought up to 2,010,700 bushels. The garners and scale hoppers are also built of steel plate, the bottoms being $^5/_{16}$ in. thick and the walls ¼ in. thick.

There are 24 elevator legs, containing continuous bucket elevators, used as follows: Eight receiving elevators for unloading cars; eight shipping elevators for loading purposes; seven transfer elevators for transfer and cleaning purposes; one elevator for screenings, and one marine elevator on the exterior of the building.

A brick stair tower on the land end of the building encloses an iron stair reaching from the first floor to the topmost floor of the cupola, and also a 5 ft. x 6 ft. passenger elevator of 2,000 lbs. capacity, with a speed of 75 ft. per minute, which also operates to the topmost floor, with intermediate landings to the other floors. One spiral stair encased in an iron tower at the river end of the building reaches to the bin floor without intermediate landings. There are also several interior iron stairs reaching from the basement to the first floor and from the bin floor to the various floors of the cupola, and one flight reaching to the roof.

All iron work was painted in the shop with one coat of New York Central standard red lead paint, and during erection the interior work received one additional coat and the exterior work two additional coats, the first being red lead and the second white lead.

The machinery is driven by 43 motors, all of three-phase induction type, without brushes, and designed to operate on a multiphase alternating current circuit of 25 cycles per second, with a pressure of 550 volts. Of these motors, 23, of a capacity of 100 h.p. each, are used for the operation of receiving, shipping, transfer and cleaning elevators; two, with a capacity of 60 h.p. each, for operating the dust collectors and the belt conveyor in the cupola; 17, with a capacity of 40 h.p. each, for cleaning machines, car puller, marine tower, screenings elevator, cross conveyor and dust collector fans, and one of 10 h.p. for the passenger elevator, to which it is connected direct.

Light for the building is furnished by 328 16 c. lamps inside and 78 32 c. lamps, arranged in clusters of three on the outside, lighting the dock. The power station from which the current for the elevator is obtained is of recent construction and is also used to generate current for the railroad station and yards, docks, transfer bridges, and the marine shop where the floating equipment is repaired. It is an excellent example of modern power station design, both in interior arrangements and in the building itself, which presents a very attractive appearance. There are four boilers of 500 h.p. each, set in pairs, one pair on each side of the stack, fitted with Roney mechanical stokers.

Coal is received from cars on a trestle alongside the boiler room, and after passing through a hopper into a crusher is conveyed mechanically to bins over the boiler room, from which it is fed to the stokers by gravity. The ashes are also disposed of mechanically by being picked up and elevated with conveyors and deposited in bins overhead at an elevation from which they can be delivered into cars.

There are four three-phase alternating current generators, all driven by Westinghouse-Corliss engines. Two of these generators have a capacity of 750 k.w. each and furnish current at 600 volts with a frequency of 25 cycles for power purposes. The other two have a capacity of 400 k.w. each and furnish current at 2,300 volts, with a frequency of 60 cycles for lighting.

The work on both the elevator and the power station was executed under the direction of Mr. Wm. J. Wilgus, Vice-President of the New York Central & Hudson River Railroad, in charge of construction, who was Chief Engineer of that company at the time the plans were made and the work commenced. Mr. H. Fernstrom, the present Chief Engineer of the company, was assisted in the supervision of construction by Mr. Olaf Hoff, Engineer of Structures; Mr. E. B. Katte, Electrical Engineer, and Mr. Joseph Stehlin, Mechanical Engineer. George M. Moulton & Company, of Chicago, were the architects and contractors for the superstructure and equipment of the elevator. Mr. Bernard Rolf was the contractor for the substructure.

Railroad Law; March Decisions.

The following abstracts cover March decisions on railroad law in the Federal courts and the United States Supreme Court:

Combinations to Obtain Rates.—A combination of packers to secure less than lawful freight rates, entered into by independent meat dealers with intent to monopolize commerce in fresh meat among the several states violates the Sherman Anti-Trust Act of 1890.—Swift & Co. vs. United States (U. S. Sup.) 25 Sup. Ct. Rep. 276.

Adverse Possession of Right of Way.—Title to right of way granted by Act of Congress cannot be acquired by adverse possession for private uses under state laws, unless the land adversely possessed was so situated that a conveyance from the railroad company would have been confirmed by the Act of Congress of April 28, 1904, validating such conveyances of the right of way as should not diminish it to a less width than 100 ft. on each side of the center of the main track.—Northern Pacific Railway Co. vs. Ely (U. S. Sup.) 25 Sup. Ct. Rep. 302.

Private Switches.—One having no property right in a private switch over the land of another cannot compel the latter to permit a railroad company to receive and ship his freight over the switch to the railroad's own track. The railroad cannot be required to receive freight on or along a private switch; its duty to receive freight being confined and limited to its own depots or shipping and receiving points.—Bedford-Bowling Green Stone Co. vs. Oman, 134 Fed. Rep. 441.

Violation of Interstate Commerce Clause by State Railroad Commission.—Carloads of coal shipped from one state into another remain subjects of interstate commerce until delivery to the consignee and hence are beyond the control of a state transportation commission. A suit to enjoin the state board from enforcing an order with reference to the shipment as a violation of the commerce clause does not properly lie against a state, since such suit is within the jurisdiction of the Federal court.—Southern Railway Co. vs. Greensboro Ice and Coal Co., 134 Fed. Rep. 82.

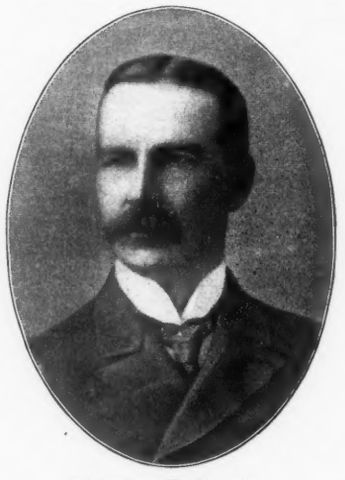
Sale of Switch by Railroad Company.—A railroad company does not violate its public obligations by the sale of a terminal switch to the owner of the land on which it is laid, and its motive in the sale does not affect the validity of its action. The purchaser of the switch can treat it as he sees fit, even to the extent of the removing the tracks.—Oman vs. Bedford-Bowling Green Stone Co., 134 Fed. Rep. 64.

Violation of Interstate Commerce Clause.—The South Carolina Act declaring that any common carrier shipping or receiving for transportation any shad fish to points beyond the state shall be guilty of misdemeanor and fined is unconstitutional and void as prohibiting the transportation of such fish caught beyond the limits of the state which the state has no power to regulate.—McDonald & Johnson vs. Southern Express Co., 134 Fed. Rep. 282.

Crossing Accident.—The presumption that a traveler killed at a crossing had exercised due care for his own safety is negatived where the highway crossed the track at right angles and the view of the track from the highway for 300 ft. before the crossing was reached was unobstructed so that a locomotive headlight could have been seen when the train was at any point on the track within a half a mile or more.—Tomlinson vs. Chicago, Milwaukee & St. Paul Railway Co., 134 Fed. Rep. 233.

The New Isthmian Canal Commission.

On April 3, the personnel of the new Isthmian Canal Commission was made public, and the names of the seven members whose portraits appear herewith, together with that



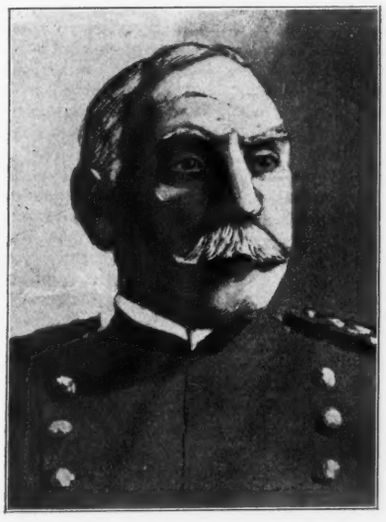
Theodore P. Shonts.

of Mr. Benjamin M. Harrod, who was on the previous commission, but whose portrait is not available at the present time, were announced. In place of Rear Admiral Walker, the Chairman of the commission is Theodore P. Shonts, now President of the Toledo, St. Louis & Western Railroad. The other members of the new commission are: Charles E. Magoon, who will be Governor of the Canal Zone; John F. Wallace, Chief Engineer; Rear Admiral, Mordecai T. Endicott, U. S. N.; Brigadier-General, Peter C. Hains, U. S. A., retired; Colonel Oswald H. Ernst, Corps of Engineers, U. S. A., and Benjamin M. Harrod. The salary schedule is rearranged somewhat and the total salaries of the new commission will amount to $102,500 a year, as against $120,000 a year salaries and allowances under the former commission. The Chairman of the new commission receives a total salary of $30,000, the Chief Engineer a total salary of $25,000, and the Governor of the Canal Zone a salary of $17,500. The other commissioners receive $7,500 each. The head of each department is allowed the use of a furnished house upon the Isthmus and his traveling expenses when on the business of the commission. Professor William H. Burr and William Barclay Parsons, who were members of the former commission, are attached to the present organization as members of the Consulting Board of Engineers in accordance

with the recommendation expressed in Secretary Taft's letter to the President that an advisory board of notable engineers be formed to report upon the kind of canal best adapted to the situation and to serve as a consulting body.

The new organization divides the work into departments and it is provided that the head of the first department shall be the chairman of the commission, with direct and immediate charge of:

1. The fiscal affairs of the commission.
2. The purchase and delivery of all materials and supplies.
3. The accounts, bookkeeping and audits.
4. The commercial operations in the United States of the Panama Railroad and steamship lines.
5. He shall have charge of the general concerns of the commission, subject to the supervision and direction of the Secretary of War, and shall perform such other duties as may be placed upon him from time to time by the Secretary of War.

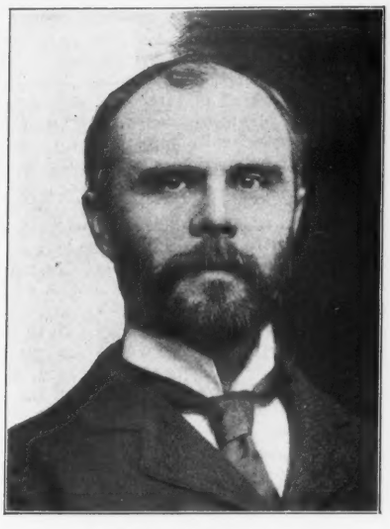


Oswald H. Ernst.

William H. Burr.

Charles E. Magoon.

John F. Wallace.

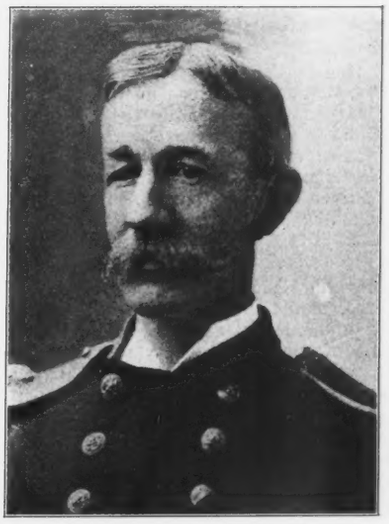


William B. Parsons.

The head of the second department shall be the Governor of the Zone, with the duties and powers indicated in the executive order of May 9, 1904, which includes in general:

1. The administration and enforcement of law in the zone.
2. All matters of sanitation within the canal zone and also in the cities of Panama and Colon and the harbors, etc., so far as authorized by the treaty, the executive orders and decrees of Dec. 3, 1904, between the United States and the Republic of Panama relating thereto.
3. The custody of all supplies needed for sanitary purposes, and such construction necessary for sanitary purposes as may be assigned to this department by the commission.
4. Such other duties as he may be charged with from time to time by the Secretary of War.
5. He shall reside on the Isthmus and devote his entire time to the service, except when granted leave of absence by the Secretary of War.

Peter C. Hains.



Mordecai T. Endicott.

The head of the third department shall be the Chief Engineer. He shall have full charge of the Isthmus.

1. Of all the actual work of construction carried on by the commission on the Isthmus.
2. The custody of all the supplies and plant of the commission upon the Isthmus.
3. The practical operation of the railroad on the Isthmus, with the special view to its utilization in canal construction work.
4. He shall reside on the Isthmus and devote his entire time to the service, except when granted leave of absence by the Secretary of War.

The President's letter of instruction in de-

fining the duties of the commission requires that it shall meet four times a year on the Isthmus; on January 1, April 1, July 1 and October 1. The entire commission is placed under the supervision and direction of the Secretary of War subject to the approval of the President. It is provided that all contracts for the purchase of supplies for construction involving an estimated expenditure of over $10,000 shall be awarded only after public advertisement in the newspapers. Bids for more than $1,000 and for less than $10,000 shall also be solicited when it is practicable to do so.

The Chairman of the new Isthmian Commission, Theodore P. Shonts, was born in Pennsylvania 50 years ago, but has spent most of his life in the West. He graduated from Monmouth College and studied law in the office of Governor Drake and General Baker at Centerville, Iowa. After two years' practice, he engaged in the promotion of railroads and has lived in Chicago since 1880. He was successively General Manager and President of the Indiana, Illinois & Iowa Railroad, the latter position dating from 1898 to 1903. At the present time, as previously mentioned, he is President of the Toledo, St. Louis & Western.

Charles E. Magoon was General Counsel of the former Panama Canal Commission. He also served for five years as law officer of the Bureau of Insular Affairs of the War Department, and in this capacity was frequently called upon for advice on questions arising in connection with the military occupation of Cuba and the Philippines. Mr. Magoon was born in Minnesota in 1861 and was educated at the University of Nebraska.

The Chief Engineer of the new commission, John Findley Wallace, who retains his old position, is well known to readers of the *Railroad Gazette*. An extended biographical notice and portrait of Mr. Wallace was published at the time of his former appointment to the commission.

Rear Admiral Mordecai Thomas Endicott, who is Chief of the Bureau of Yards and Docks, was born in New Jersey in 1844 and graduated from the Rensselaer Polytechnic Institute in 1868. He remained a Civil Engineer in private practice until 1874, when he entered the Navy, and he has held his present bureau appointment since 1898. He was a naval member of the Nicaragua Canal Commission of 1895 and has had extended experience in designing dry docks.

Brigadier-General Peter C. Hains, U. S. A., retired, served in the defences of Washington, in the Manassas campaign and in the battle of Bull Run, during the Civil War, and was Chief Engineer of the Thirteenth Corps in 1863. After that he was Superintending Engineer of the construction of the defences at Natchez, and was Chief Engineer of the Department of the Gulf. He was a member of the Nicaragua Canal Commission in 1897 and 1898, and was also a member of the commission to determine a route for a canal across the Isthmus of Panama.

Brigadier-General Oswald H. Ernst, Corps of Engineers, U. S. A., was born in 1842, and graduated from West Point. He was made a First Lieutenant of Engineers shortly after his graduation and received his present rank in 1903. He has had extended experience as a member of engineer boards in river and harbor improvements, bridge building, etc. He was sent to Spain in 1870 as astronomer to observe the solar eclipse. In 1899 he was appointed a member of the commission to determine a route for a canal across the Isthmus.

Benjamin S. Harrod, of Louisiana, is a Civil Engineer who was appointed to the former commission to represent the interest of the south and southwest.

We are indebted to the courtesy of the *New York Tribune* for the majority of the accompanying portraits.

Committee Report on Signaling.

The report of Committee No. X, of the American Railway Engineering and Maintenance of Way Association, on signaling and interlocking, which was presented at Chicago March 21 and was briefly noticed in the *Railroad Gazette* of March 24, begins with a brief historical sketch, in which is incorporated a copy of the plan of the first interlocking, which was presented at Chi- East Newark, N. J., on the Pennsylvania Railroad in 1874). In connection with this there is given a plan of the same tracks signaled in accordance with the approved practice of the present day, with a comparison, made by Mr. Sperry several years ago, of the merits of the old and new methods.

Continuing, the historical chapter says: During the decade 1880 to 1890 there was a demand for interlocking plants by the railroad companies and also by the railroad commissions of states where these had jurisdiction. The prevailing practice was to combine a number of functions so as to operate from one lever or wheel, the idea being to reduce the cost and perhaps to avoid the use of patented apparatus owned and manufactured by Saxby & Farmer and Stevens, of England. The capstan wheel machine (one of a number of designs) was used extensively; some of these machines are still in service, although no new installations have been made in the past 15 years. One wheel operated in sequence a derail, a home signal and a distant signal. At a single-track crossing four wheels were required to operate the four derails and eight signals. The wheels were placed in a suitable tower (cabin) and interlocked by means of a modification of the Stevens type of locking. Wire cables connected wheels to functions in series. While the cost of installation and maintenance was undoubtedly less than for the Saxby & Farmer or Stevens equipment, the operation was slow and ill-suited for any extensive or complicated switch and signal arrangement, and may be fairly considered a backward step in the art. The other machines embodying the same idea of combining a number of functions to operate on one lever are relatively unimportant, never really getting beyond the trial and experimental stages.

When the "lever machine" with latch locking became generally recognized as the best for operating mechanically connected interlocking switches and signals, the idea of moving and locking the switch with one lever was retained, and wherever practicable one lever moved and locked two switches; by so doing the cost of installation is reduced; but, generally speaking, this increased the cost of maintenance and made the operating levers too heavy. Overloading levers to economize in number is now generally recognized as bad practice and false economy.

From 1885 to 1890 a device known as the Signal Indictor was popular; it was used in combination with a one-arm signal at points where there was a number of diverging routes, to show what route was set. A great many were installed, but they were not thoroughly reliable and were found to add to the confusion they were supposed to guard against; so they have been abandoned, and it is doubtful if any can be found in use today. The recognized best present practice for mechanically connected interlocked functions is to keep switches, locks and signals on separate levers; sometimes a lever operates one switch and one lock, or two switches or two locks, and by interposing a selector two signals are sometimes operated by one lever; but this last is not considered the best practice.

Standard Arrangement of Signals at Interlocking Plants.

In this chapter the committee gives 15 diagrams of crossings, junctions, crossings and junctions combined, and other common combinations of tracks, with the proper signaling for each. The report says:

It is desirable that signals be arranged to give full information. . . . As three, four and six track combinations were developed, the effort to give a separate signal indication for each route resulted in a multiplicity of signals confusing to the engineer, as many as six arms being required in some cases. Practice has demonstrated that the spacing should be not less than 6 ft. to properly distinguish signals at a distance; this would require a mast of great height.

The practice on some roads is to distinguish between freight and passenger tracks by placing the signals higher for the passenger track than for the freight; but as tracks are now used interchangeably for passenger and freight service this method is objectionable.

An arrangement of interlocked signals that shall give the number of routes and the direction of divergence from a main or nominally straight route is in many cases impracticable and insufficient when practicable, unless the signification of the speed at which movements may be made over each route is added. This speed signification is made as clear as possible and at the same time logical; easily understood and easily explained to enginemen, by locating the signals governing the high speeds high on the masts, and the signals governing low speeds low on (or near) the masts.

While the addition of a third high-speed arm under certain conditions may be desirable, your committee is unanimous in its opinion that as a rule only two high-speed arms should appear on one mast. With two high-speed diverging routes the third arm may be useful. Such an arrangement gives the enginemen information as to which of the two diverging routes is set, and this might prevent trouble if the operator made the mistake of setting the wrong route; but the engineer is supposed to take the route given him. A mistake of this kind is not likely to occur, because the engineer must stop and investigate if he should be given other than his regular route without having previously received orders. A mistake that might result in a collision cannot be guarded against by the addition of signals, unless the responsibility for accepting a route is placed on the engineer; this is obviously impracticable. So is any effort to give signal indications for more than the general subdivision of high and low-speed diverging routes. Your committee discussed the question of providing an indication for intermediate speeds, such as tonnage trains are required to make in a movement from main line to passing sidings, in order to avoid stalling, and to get out of the way of passenger trains promptly. This condition is provided for in this way: If the siding is provided with a long flat turnout, it should be signaled as a high-speed diverging route; otherwise it must be governed by a low signal. It has become recognized as necessary to have long flat turnouts for important branch lines and long flat crossovers for the passage of trains from one main track to another main track in order to run around slower trains. We are of the opinion that one arm is sufficient to govern all diverging routes of this character; but they should be made with some restriction in speed and the lower arm implies this; the top arm always refers to the highest speed route.

The signals for low-speed routes should be low and of dwarf construction. According to the present practice low signals are used for all low-speed routes, except the ones where they are most needed, namely, move-

ments from a main line in the established direction to a siding or spur or to another main line against the established direction; many accidents have resulted from the present practice of giving a high arm for this movement. We believe it is correct to govern every low-speed route with a low signal.

A separate distant signal should be provided for each high-speed home signal. The present practice is to install distant signals for the highest speed only; with this arrangement trains given high-speed diverging routes are required to run "prepared to stop" at the home signal; and the value of the high-speed home signal is thereby decreased. Enginemen who are accustomed to get a high-speed route regularly will disregard this rule and interpret the caution indication relating to the highest speed to mean the "diverging high-speed route is clear"; this is dangerous and the value of the distant indication is decreased, whereas in this day of high speeds the value of the distant indication should be increased and rigidly observed.

Our sixth recommendation in regard to the color stop indication and the position stop indication for all home signals is inserted here because there has developed recently a tendency to depart from the present almost universal practice. Your committee believes that red is so firmly established as the "color stop indication" and the horizontal position of the arm as the "position stop indication" that they should not be disturbed. Blue has been used as the color stop indication for low-speed dwarf signals, governing movements from one side track to other side tracks or a main track, and has been suggested for all signals governing low-speed diverging routes. The argument for this is:

(a) That it will not be mistaken for a non-interlocked switch displaying a red light (the switch light does not necessarily mean stop).

(b) That it would serve to better distinguish between high-speed and low-speed signals, and between interlocked signals and automatic signals. It would also reduce the number of red lights that high-speed trains would pass.

It seems very necessary to distinguish between home automatic signals past which at the stop indication trains may proceed under restrictions and other home signals requiring a stop until signal is cleared. Most roads have some sort of distinguishing mark for this purpose, . . . and one road has a system which requires every high interlocked signal to display two arms and two lights. The lower arm is frequently a "dummy"—not operative—since at many points there is only one route to be governed; in such cases it always displays a stop indication. Where green is used for "proceed," yellow for "caution," and all automatic signals carry two arms (one home and one distant), this method has only two bad combinations in the possible total of 18; (1) red above green, which for an interlocked signal means "proceed" at second highest speed; while such a combination at an automatic signal means stop (the distant arm is stuck at clear); (2) two green lights mean "all clear" for automatic signals, while for interlocking signals two green lights indicate that both distant arms are clear through some derangement.

One road has put on the automatic signal post an illuminated letter "A" as a distinguishing mark; the disappearance of this mark converts it into an absolute stop signal. It is presumed that at interlocking plants the lights being under constant supervision and within the visual range of the leverman, an extinguished light is immediately discovered; for this reason the additional lamps should be carried by the automatic signals instead of the interlocked signals. Levermen frequently extinguish lights through rough handling of the levers and fail to notice it. A great many accidents have occurred at interlocking plants because of extinguished lights. A compromise suggestion to put an illuminated letter on all interlocked signals, locating it in such a way that it would not be mistaken or could not substitute a signal, was discussed by your committee, but failed to receive approval of the majority, so that while we recognize the importance of a distinguishing mark and of having this mark uniform for all roads, your committee has failed to agree on a specific recommendation, submitting a general one and pointing out the present variety in practice, hoping that the discussion may bring out one that can be adopted as standard. Interlocked signals relate to the use of track within the limits of an interlocking plant. Where a block system is in force there should be signals placed at or near these limits to give permission to proceed beyond into the block.

The Association has adopted the principle of continuous light for arm castings. This requires signal arms in the "proceed" position to be very close to the prescribed angle. From the Railway Signal Association's investigation of the subject of wire connected signals it is shown that they are not safe when operated more than 2,000 ft. from levers, as it is then found impossible to get reliability and accuracy in varying temperatures with wire connected signals. Electric signals are coming to be extensively used for distant interlocking signals. Since the distant signal is used only in connection with high-speed routes, they are required to be located 3,000 or 4,000 ft. from the interlocking tower. At this distance the operation by means of pipe line would be very difficult and expensive. All high-speed signals that are operated mechanically should have pipe connections. . . . To be perfectly safe, every movement made at an interlocking plant should have an interlocked signal to govern it.

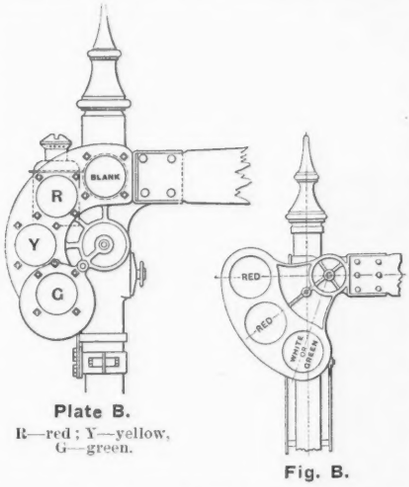


Plate B.
R—red; Y—yellow, G—green.

Fig. B.

Fig. B shows the outline of a design for continuous light arm casting now used extensively by many roads. It will be necessary, before detail drawings can be submitted, to have the Association decide on the sweep of the arm. This should be either 60 or 70 deg.

Conclusions.

1. That . . . the first object in arranging interlocking signals is to indicate *routes* for trains, and, secondarily, as a necessary consequence, *speeds* for trains.

2. That high-speed movements be governed by high signals, and low-speed movements be governed by low signals.

3. That only two high-speed signals be displayed on one mast, the top arm to govern the unrestricted speed, and the lower arm to govern all other high speeds.

4. That all low-speed movements be governed by one-arm low signals of dwarf construction.

5. That a distant signal be provided for each high-speed home signal.

6. That "red" be the "color" stop indication, and that the "horizontal" position of the arm be the "position" stop indication for all home signals.

7. That a mark of distinction be made between automatic block signals, and all other home signals, whether interlocking, train-order, or manually operated block signals.

8. That home block signals [starting signals] be provided at all interlocking plants used as block stations.

9. That all mechanically operated high-speed signals be pipe connected.

10. That one distant signal only shall be provided for a high-speed route, and when "clear" it shall mean that all high-speed home signals along that route through the interlocking plant, including the home block signal, are "clear."

11. That every movement within the limits of an interlocking plant shall be governed by an interlocking signal.

MANUAL BLOCK SIGNALS.

The chapter on telegraph and controlled manual block signals begins with the "requisites of installation" and adjuncts prescribed by the American Railway Association. Following this is a table showing the miles of road operated by manual signals. The roads replying to the questions propounded as a basis for this table operate about 100,000 miles of line. A number of important roads do not answer, which makes the table unsatisfactory. Moreover, we note a number of discrepancies between this and the table printed in the *Railroad Gazette* of January 27 last, though both tables are based on official information. As some of the figures in the present table are larger than those in our own and others are smaller, the discrepancies cannot be explained by a difference in date of the two tables. No date is given in the committee's table. Most of the roads reporting say that their block signal rules are those of the American Railway Association, adopted in April, 1900. The Long Island and the Southern Pacific use bell codes in place of the Morse telegraph for the "telegraph" block system. The practice of the different roads in the matter of permissive signaling and the use of caution cards is set forth at length. The use of the same form of fixed signal for train orders and for telegraph block signaling is almost universal, and the committee therefore believes that train-order signals and telegraph block signals should be of the same design. Referring to the location of fixed signals, the committee says: The location of the signal on the block station is awkward, because when the block station is in the passenger station trains are often obliged to run by it at danger when coming to the station or doing work in its vicinity. The one-arm one-mast signal can be placed a few hundred feet in advance of the station and the train makes its stop before reaching it. When allowed to proceed the arm can be cleared for it without it being necessary to issue a clearance card. This saves work and time and is the correct practice.

Where permissive signaling is practiced the committee recommends a three-indication arm; its position for the proceed indication to be vertical and for caution at an angle of 45 deg. Continuing, the report says: It is a good plan to put an electric slot on the signal-arm connection to insure the return of the arm to danger as the train passes. It is an additional safeguard and

especially valuable in the absolute block system. While it does not prevent the operator from giving a wrong indication in the case of permissive blocking, it requires him to reset the signal for each train.

The construction and method of operation of controlled manual signals are briefly described. The committee makes no recommendations concerning the details of this system, evidently believing that it is destined to be superseded by automatic signals. The first three conclusions at the end of this chapter are:

1. The best location for the Telegraph, and Controlled Manual, Block Signal is on a mast alongside and to the right of the track on which are run the trains that it governs; but, in the case of more than two tracks, when it is impracticable to spread them apart for this purpose, then the best location is on a bracket post, or on a bridge over the tracks.

2. It is good practice to make use of the electric slot to send the signal to normal position, "Stop," as the train passes.

3. The best "Arm" for the "Telegraph," and "Controlled Manual Block Signal" to be adopted as standard by the Association is the one illustrated in Plate B.

The fourth recommendation is for a standard plan for leadout, pipe runs, and signal connections, which is shown in the appendix. The fifth is for the adoption of a code of specifications for the construction of telegraph block signals and connections, and the sixth is a recommendation for the adoption of a code of definitions. These two codes appear to have been drawn with much care.

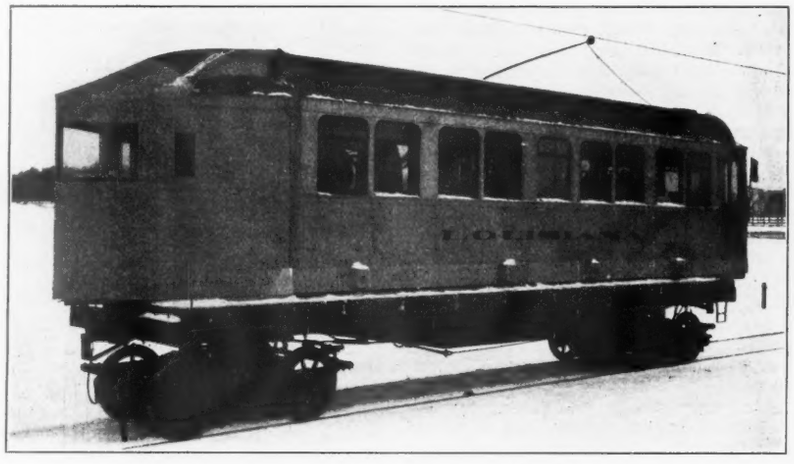
Plate B is accompanied by a detailed drawing showing in full the dimensions of the semaphore arm casting. The upper spectacle in this casting is available for use where the upward inclination of the arm is used for an indication. Where white is used for all-clear and green for caution the colors of the glasses, beginning at red and reading downward, would be red, green, white. Where used as a two-position signal, the glasses, beginning at red, would be reading downward, red, red, white; or red, red, green.

The report is signed by J. C. Mock, Michigan Central, Chairman; W. C. Cushing, C. L. Addison, F. H. Alfred, Chas. Dunham, Lawrence Griffith, A. H. Rudd, W. A. D. Short, Thos. S. Stevens and J. E. Taussig.

Recent Work of the Electric Railway Test Commission.

The Electric Railway Test Commission, consisting of Messrs. J. G. White, H. H. Vreeland, J. H. McGraw, W. J. Wilgus and G. F. McCulloch, which was appointed more than a year ago by President Francis, of the Louisiana Purchase Exposition, to investigate numerous problems of electric traction in consultation with Prof. W. E. Goldsborough, Chief of the Department of Electricity at the Exposition, has nearly completed the field work which was outlined. Immediately after the appointment of the commission, preparations were begun for carrying out tests at the Exposition and elsewhere, and a large corps of observers was selected from a number of the prominent technical schools to assist in the work. The tests conducted, which were begun last summer, comprised the determination of the alternating current losses in rails; efficiency of various methods of braking and accelerating both city and interurban cars; the energy consumption of cars in different kinds of service and the air resistance of cars at high speed. The tests to determine this last factor have been made on a stretch of track 25,000 ft. long on the line of the Indiana Union Traction Company, and all of the apparatus has been specially designed and constructed for obtaining accurate results.

The special dynamometer car which was used was designed for the purpose of measuring directly the head end and rear end pressures and the roof and side resistances of car bodies. It was built in the shops of the Indiana Union Traction Company at Anderson, Indiana. The equipment for the car was secured partly by loan and partly by purchase of supplies from funds donated to the work by various electric and steam railroad companies and by engineers interested in the investigation of important railroad problems. The Indiana Union Traction Company, in addition to the facilities offered in their shops and offices, placed at the disposal of the commission a pair of high-speed Baldwin trucks and a set of four Westinghouse No. 85 motors, rated at 75 h.p. each. The Baldwin Locomotive Works made the changes in the center plates and side bearings of the trucks necessary to enable them to turn freely under the frame of a steel flat car loaned by the Pressed Steel Car Co. A motor-compressor of ample size with governor and brake-cylinder was furnished by the National Electric Company, and the test corps designed and constructed the special brake rigging necessary to adapt these to the steel car frame. A powerful hand-brake rigging was also constructed, using the "Peacock" brake drums supplied by the National Brake Company. Special "bumpers" were constructed to prevent damage to other cars in coupling, and heavy chains were used to prevent excessive motion of the car frame with respect to the trucks. As the frame was raised considerably above its usual height by the changes mentioned, this was considered desirable.



Test Car for Determining Air Resistance at High Speed.

The dynamometer equipment, consisting of an interurban car body, 32 ft. long without vestibules, rolls freely upon rails screwed to the flat car floor. This body together with a special steel vestibule and a standard vestibule were supplied by the J. G. Brill Company. Under the side sills of the dynamometer body are mounted eight Chapman double-ball bearings, and these carry four axles $3^{7}/_{16}$ in. in diameter and 9 ft. long. Mounted on the axles are chilled wheels, 12 in. in diameter with ground treads. The rails are also ground where they come into contact with the wheels. By this method of mounting there is, for practical purposes, no friction between the body and the flat car floor. The body is restrained from excessive motion by effective safety devices. The pressure of the air upon the body is measured by means of scale beams, constructed for the tests by Fairbanks, Morse & Company, and loaned by them. The beams are supplied with dash-pots and the weighing mechanism consists of the regular beam with weights and poise, and in addition a spring balance with dial is employed to render easier the manipulation of the machine.

A successful plan has been carried out on this car for the purpose of separating the head and rear resistance from the total. The vestibule is independent of the body but is carried by means of a link suspension. In order to guide the vestibule and to transmit the pressure to the weighing device a steel-trussed oak frame, attached to the vestibule, projects into the car a distance of 8 ft., and it is guided on all sides by small Chapman bearings. This method of suspension has proved very satisfactory. In order to secure stability of the vestibule and body, each of these is held against the scales by counterweights, the forces of which are transmitted through bell-cranks and levers, all equipped with knife-edge contacts.

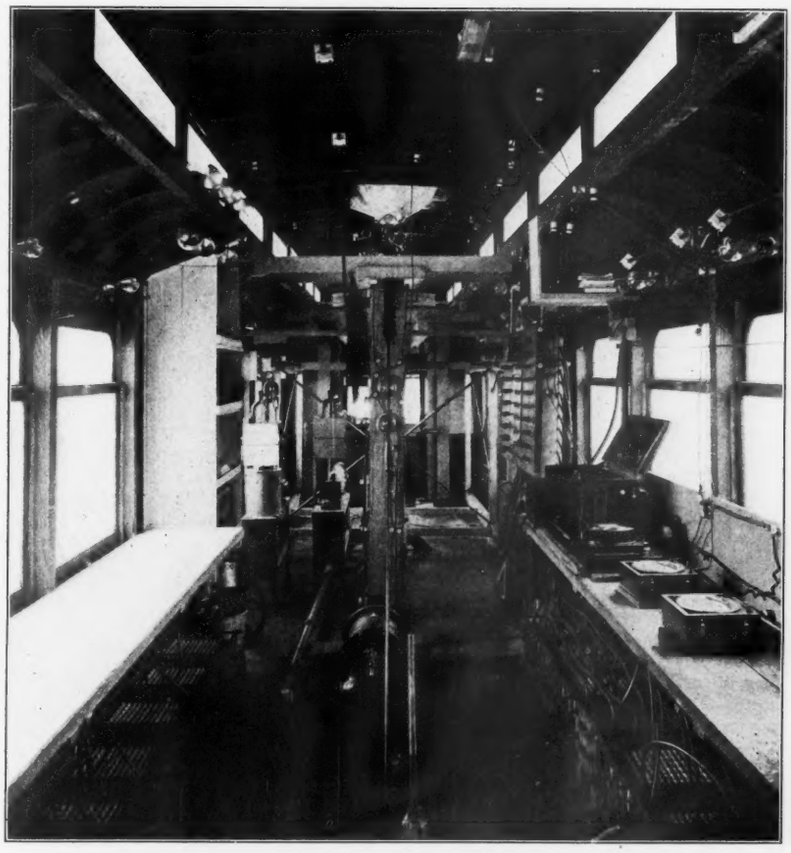
In order to eliminate from the measurements all forces but those due to the air, the controllers are mounted upon iron stands carried upon the flat car floor and projecting into the car body, thus removing the effect of stiffness in the controller cables, a serious matter in a car of this size. Similarly the trolley base is inside the car, carried upon the top of an oak post which projects upward from the flat car. No error is possible, therefore, from the resistance between trolley wheel and wire. While the forces mentioned are small in amount, the sensitiveness of the apparatus is such that the precautions taken were necessary.

The air resistance car was built by the test corps in about three months' time. This work included the assembling of the equipment, the construction of the special brake rigging and other equipment with the exception of the heavy steel and wood work which was done by outside parties from the funds of the Commission. The test corps also wired the car for a double-end controller arrangement, one controller of the Westinghouse "L4" type being loaned by the Traction Company, the other by the Westinghouse Company. The latter also supplied a pair of circuit breakers and a large number of resistance grids for controlling the running speed of the cars.

To make exact measurements of all of the quantities involved in these tests, especially in regard to the matter of speed, two independent plans were employed. The test track, somewhat over 25,000 ft. long, was divided into sections of 1,000 ft. each. The sections were marked by large signs plainly numbered. The instant of passing each sign was indicated on the graphical record of a General Electric recording ammeter which

was also used for the current record. This ammeter records upon a strip of paper regular intervals of five seconds each. Upon this record was superimposed the time of passing each of the section signs, this being accomplished by closing a switch for an instant as each of these signs was passed.

The other speed-recording device consists of a small dynamo carried upon the truck frame and geared to the car axle by sprocket wheels and chain. This dynamo is an "Apple" igniter made by the Dayton Electrical Mfg. Co. It has permanently magnetized field poles, but these also carry exciting coils through which the field current of the recording ammeter is also passed. As this current must be maintained accurately at a value of one ampere for current measuring purposes, it is admirably adapted for the purpose mentioned. The e.m.f. generated by the dynamo is read upon a Weston voltmeter specially arranged for this purpose. The e.m.f. at 60 m.p.h. is about seven volts. The readings are directly proportional to the speed. This apparatus has now been in operation for some weeks and has demonstrated its accuracy and convenience.



Interior of Test Car for Determining Air Resistance at High Speed.

In addition to the speed measurements, accurate readings at five-second intervals of motor e.m.f. are recorded and the current record is continuously checked by means of a direct-reading ammeter in the same circuit. The direction and velocity of the wind are also taken at frequent intervals, accurate anemometers having been supplied by Queen & Co. for the purpose.

The tests on the "Louisiana," as the air resistance car has been named, will continue until sufficient data are at hand to determine the resistance to the motion of different shapes of car front at all speeds reached by modern interurban cars up to 70 miles per hour, this limit being set by the line and motor capacities. A speed of 72 miles per hour has been reached for a short period.

During the past few days another important investigation has been completed by the use of a car exhibited by the Cincinnati Car Company at the Exposition. This car is supplied with the same motor equipment as the "Louisiana," but it has in addition the latest type of Westinghouse electro-pneumatic control. The tests made upon this car were designed to supplement those previously made and to supply important data, not only in regard to the control system, but having reference in general to heavy interurban car operation problems. An interesting feature of these tests was that all records were taken autographically on a special recording table. A wide strip of paper is carried by motor power across a glass table on opposite sides of which the observers are stationed with their instruments. Opposite each is a guide and pencil carriage, the latter being operated by a cord carried over a drum attached to a pointer over the instrument needle. The observer simply follows the motion of the needle with his pointer and the result is recorded. The base line for each record is traced by a separate pencil carried by an electro-magnet through which passes the current from a time-marker recording five-second intervals, thus synchronizing all of the records.

The results of all the work of the Commission will be published in full in a report to be issued as soon as practicable after the completion of the work.

The representatives of the British Government at the International Railway Congress are announced as follows: Honorable Gathorne Hardy, Sir Francis Hopwood, Colonel H. A. Yorke, W. H. Macnamara, W. M. Acworth. The Indian Government will be represented by Colonel Cowrie, L. H. Yates, and H. Burt. The representative of the Russian government is to be M. Tscheremissinoff, chief administrator of Internal Communications.

Proposed Subways in New York.

The Rapid Transit Commission's committee on plans has been at work since the first of the year mapping out new routes for additional subways in New York. The committee has considered suggestions submitted by representatives of all the boroughs comprising portions of New York City; by the principal railroad corporations and by individual builders, and it now submits for selection 19 new routes. It is not proposed that all of these should be contracted for, but trunk systems on the east and west sides of Manhattan and lines running to Brooklyn and The Bronx making a junction with existing lines are contemplated. The Commission will select routes which offer the greatest inducements to the public. The 19 plans printed herewith are intended to prove rather as concrete suggestions to direct the bidding than as final proposals. They are as follows:

1. East Side route on First avenue from The Bronx to the Battery.
2. West Side route via Ninth and Columbus avenues from the Battery to West 211th street.
3. East Side route on Third avenue, from The Bronx to the Battery.
4. Route in Seventh avenue from Forty-second to Twenty-fifth street, either a one-track subway or a two-track subway.
5. A four-track subway under Lexington avenue from 127th street to Forty-second street.
6. A crosstown three-track subway through Fifty-ninth street from Twelfth avenue to the terminus of the Blackwell's Island Bridge, crossing the bridge to Queens.

6A. A crosstown subway in Thirty-fourth street, from Ninth avenue east to the Thirty-fourth street ferry.

7. A crosstown subway from the West Twenty-third street ferry to the East Twenty-third street ferry on Twenty-third street.
8. A crosstown subway through Fourteenth street from Eleventh avenue to a point between Avenues B and C, where it is proposed to connect with the tunnel to Brooklyn.
9. A subway from Broadway and Fulton street, Brooklyn, through Broadway, over the Williamsburg Bridge to Delancey street, and through Centre street to the proposed new terminal at the Brooklyn Bridge, with a spur of two tracks in Walker and Canal streets to connect with and cross the Manhattan Bridge; a spur through Grand street and Desbrosses street to the Desbrosses street ferry; a spur through William street; a spur through Beekman street; a two-track subway from Broadway and Gates avenue, Brooklyn, through Gates avenue to Bedford avenue; through Bedford to Lafayette to Fulton street.
10. A subway from Broadway and Union avenue, Brooklyn, through Union avenue, North Seventh street, under the East river to Fourteenth street, to connect with Route 8.
11. A four-track subway through Fourth avenue, Brooklyn, from Atlantic avenue to Fiftieth street.
12. A two-track subway through Eastern Parkway from Flatbush avenue to Pitkin avenue, to Georgia avenue, to Broadway and Fulton street.
13. In Jamaica avenue from Broadway and Fulton street to Jamaica and Maples avenues, four tracks.
14. A three-track extension of the present West Side elevated road from 230th street and Broadway to Van Cortlandt Park.
15. From the elevated station at 155th street and Eighth avenue over the Harlem river, under 161st street to Jerome avenue to Gerard avenue and Clark place, three tracks.
16. A three-track elevated road in Jerome avenue from Clark place to Woodlawn.
17. From 138th street and Third avenue to

Gerard avenue to Jerome avenue, to connect with Route 16, two tracks.

18. From 177th street and West Farms road to Morris Park avenue, to White Plains road to Wakefield at East 233d street, three-track elevated.

19. From 138th street and Cypress avenue to Southern Boulevard, to Westchester avenue, to the village of West Chester at Williamsbridge road.

Locomotive and Train Handling.*

A few years ago the locomotive was looked upon as a thing of life, and was almost considered by the engineer as belonging to himself; but now competition demands that the engine work day and night, and the personal interest is lost. When the men were assigned to steady engines it was a common thing to run an engine in passenger service 1,000 miles a week, and keep them out two years or more between shoppings, and from 18 months to two years in freight service, making 4,000 miles a month. Now we think we are doing well if we get 75,000 miles out of a passenger engine, and 45,000 out of a freight engine between shoppings. When the men were assigned steady engines, they certainly did more to get mileage out of them than they do at present. However, it remains with the management to decide which method pays best.

The engineer of to-day is only an engine runner, and his duty is to run anything that may be given him; and book any defect he may find in the work book at terminals after looking over the machine when he gets in.

The average engineer will do this faithfully, but occasionally we find a man who gets off at the home terminal, and takes off his overalls, puts them away and goes home without ever booking any work, not even looking for any to book. This class of man is in the minority, I am glad to say, but still we have them with us. You frequently find their names on the suspended list.

The greatest trouble is that many do not state intelligently what is wrong, and the shop man does not know where to begin. A man comes in with an engine and he books "left injector will not work," or "driver brake will not remain set," or "engine does not steam—pistons or valves blowing," and many other things which would be easily overcome if booked intelligently.

If a man books "injector will not prime," or "injector will prime, but will not put water in the boiler," or if he books "air-brake on drivers releases through the triple exhaust," or "releases over a defective packing leather," or "through a leak in piping between cylinders," or "an auxiliary leak," the fitter will find it immediately and have the defect repaired without delay.

Engineers have quite an influence over the firemen. If I find two men on an engine that do not harmonize, I also find an untidy, poorly-kept engine, and the sooner they are separated, the sooner things will right themselves. Men of like dispositions should be kept together, because they are always trying to do as well or better than the other fellow, when properly mated. If an engineer likes his fireman, I find he will help him in many ways to try to keep him, and in helping him he is often helping the coal pile, and doing the company's work at a reduced cost.

I am not going to lay down any special rule for the handling of the engine, but expect every engineer will try to make as good time and pull as heavy a tonnage, and as economically as the other men, and if he does this, all things being equal, I will not say much to him on this line.

The successful engineer usually handles an engine by sound and speed, and, after opening the throttle, instinct, or, rather, practice tells him when to shorten the cut-off. Locomotive valves are not always set alike, and we find some that will clear themselves of steam "hooked up" full, with a full throttle, while others seem to choke and the throttle must be eased off a little, or the reverse lever lowered a notch in the quadrant. An engineer should be a good air-brakeman. Air-brakes on passenger trains have been with us for years, but we find with long heavy freight trains that the man must understand the construction and care of the air-brake equipment to give a good service. We test our engine air pressure gages every day to prevent any possibility of accident.

When taking charge of a locomotive the engineer and fireman are instructed to start the pump slowly with drip cocks open to carry off condensation, and to run the pump slow till the pressure is at least 20 lbs. in the main reservoir. This is to prevent damage to heads, piston rods and reversing stem, by piston being thrust up and down in cylinders before there is any pressure to cushion it; and while the pump is running slow, to oil the air end, by putting a small quantity of valve oil in the oil cup, and open cup on downward stroke. The air being drawn in on this stroke will take in the oil and spray it around the walls of the cylinder. Too much oil in the air-cylinder leads to pump heating. We instruct our men when coupling on to a train to apply the brakes and leave them applied until the hose are coupled, releasing brakes and charging train at same time by going to full release position. This relieves the brake gear of the heavy shock given by the sudden opening of an angle cock when coupling up. It is good practice to blow out main reservoirs daily, and also to blow out engine piping at rear angle cock before coupling to train. This has a good effect on the working of the rotary in the engineer's discharge valve. When testing brakes at terminals, it is good practice to always release in running position, as the inspector will have an opportunity of finding any brakes that are hard to release, due to dirty triples, leaky or bad fitting rings. The brakes that can be released in this position at a terminal will readily release in full release position when on the road. We find a large proportion of our defective brakes in this way and since we adopted this method we have reduced the number of slid flat wheels on our cars.

When applying brakes for testing, and at all times, we note the length of time the train line exhaust blows, as a man can tell how many cars are operative in his train by the length of the exhaust. Should an angle cock be closed either accidentally or maliciously while standing at a station or water tank, an application of the brake will tell the tale, and possibly save serious damage. When applying brakes on a 30-car train a 15-lb. reduction will cause the train line exhaust to blow 18 seconds. A 50-car train should cause it to blow 30 seconds. If the engineer finds the exhaust stops blowing in less time than this, he may conclude that he has not got control of all the brakes. To make a service application of the brakes on a freight train, the initial reduction should always be sufficiently heavy to force all pistons out past the leakage groove in the brake cylinder, which should be approximately:

5	lbs.	for.....	10 cars.
6	lbs.	for.....	20 "
7	lbs.	for.....	30 "
8	lbs.	for.....	40 "
9	lbs.	for.....	50 "

then wait for the train slack to adjust itself and follow up with such reduction as may be necessary to bring the train to rest, leaving the brakes set until the train has stopped. I think this rule of leaving the brakes on until stopped will eventually be adopted on passenger trains of 10 or more cars, as it is almost impossible for an engineer to release brakes at a slow speed on trains of this class without doing damage. I think the "two application" stop will still be retained, but I believe that the first application on a passenger train at a high speed should be heavy; then no serious effect is felt, but the heavy pressure should be released fully from the brake cylinders when speed is reduced to about 15 miles per hour; and the final application, which will be much lighter, should be left on until the train stops. A retainer on driver brake gives good results when releasing at a low speed, and is very useful in holding either engine or train on a grade while recharging, or at a water tank.

When descending grades where the retainers are required we have no set rule as to the number to be used, but we instruct our men to use enough to control the speed of train as they would with hand brake; but we always insist on the use of retainers when we expect to meet a train at the foot of a grade or anywhere on a grade, so that if the engineer may require to release the brake he will have some braking power to control the speed while he is recharging. When picking up cars at way stations we often find brake-shoes frozen to the wheels, which will cause them to slide and make flat spots. We instruct our trainmen to see that they are all free from the wheels before leaving the sidings, and we also insist that they see that all brakes release after making a stop, either by going over them as the inspectors do, or by standing on the ground and watching them as they pull by. In the winter season we experience a great deal of trouble with leaky hose gaskets. The hose seems to freeze and refuse to bend, and the only relief is a "hinge-working" at the gasket joints, which causes them to leak and give no end of trouble. This is the season of the year when the patience of the engineer and the capacity of the pump are tried severely.

In many cases the leaks at hose gaskets are so bad that when a train is stretched the air pressure in the train line will fall from 70 to 50 pounds, giving a full service application of the brakes on the entire train. We have instructed our men not to run the pump faster than 70 double strokes, or 140 exhausts per minute, and if the pressure cannot be kept up at that speed, all the men on the train go to work to stop the leaks, sometimes by changing the gaskets, and sometimes by putting water and snow on the old ones and allowing them to freeze over, which generally stops the leak, but is disastrous to the hose in the event of its being pulled apart.

Our company have been testing a flexible hose which has given considerable satisfaction. It is of a very light but strong fiber and does not freeze so quickly as the standard air hose, but is a little more expensive.

A member having referred to the damage done to hose by pulling them apart without uncoupling, Mr. Blyth told of a certain terminal yard where 400 new hose were used each week, but where, after a boy was engaged to follow the car checker around and uncouple the hose at all points where the checker made a mark to have the trains separated, the number of hose renewed was in a few weeks reduced 50 per cent., or to 200 a week.

In the chalk district around Basingstoke, the London & South Western hauls water for its locomotives 125 miles.

*Extracts from a paper read before the Canadian Railway Club, Montreal, Feb. 7, by Walter S. Blyth, Traveling Engineer, Canada Atlantic.

GENERAL NEWS SECTION

NOTES.

A press despatch from Hornellsville, N. Y., says that the Erie is taking one brakeman off from each freight train, reducing the number from three to two.

During the month of March the Baldwin Locomotive Works completed 226 new locomotives, which is the largest month's production in the company's history. In addition many old locomotives were repaired.

On March 23 the New York Central moved on its lines east of Buffalo (not including the Boston & Albany) 30,043 freight cars. This required 621 trains, with an average of forty-eight cars to the train, and was in addition to more than one thousand passenger trains, making 1,621 trains in all.

The Superintendent of Passenger Transportation of the Pennsylvania Railroad has issued an order directing passenger trainmen to co-operate with the Postal and Western Union Telegraph Companies in delivering telegrams addressed to passengers on trains. The telegraph companies have been requested to exercise more care in securing sufficient addresses for telegrams intended for delivery on trains. The name or number of the train should be given and the stations between which the passenger is traveling.

Railway Appliance Exhibition.

Announcement is made that the office of the Secretary and Director of Exhibits of the American Railway Appliance Exhibition, to be held in Washington at the time of the International Railway Congress, has been moved to the New Willard hotel. J. Alexander Brown is Secretary and Director of Exhibits.

Bounty Offered to Shipbuilders by Canada.

Announcement is made that the Canadian Government offers a bounty of $6 per ton to encourage steel shipbuilding in Canada. This was strongly urged by the Halifax Board of Trade and applies to the whole of the Dominion. Some time ago, the city of Halifax and other municipal authorities offered a joint cash subsidy of $300,000 to any company that would establish a steel shipbuilding plant at Halifax.

New Anchor Line Steamship.

The new Anchor Line steamship Caledonia arrived in New York on April 2, on her maiden trip. She is a twin-screw steamer of 10,000 tons gross and 16,000 tons displacement, 515 ft. long over all, 58 ft. wide and 26½ ft. deep. The Caledonia is 15 ft. longer than the Columbia, of the same line, which has hitherto been the largest steamer running to the Clyde.

A "Constructive Strike" in Italy.

According to press reports, an interesting situation that is called a "constructive strike" is engaging the employees of some of the Italian railroads at present. To fully appreciate the story it should be known that railroad operation in Italy is largely prescribed by government regulations, which are very largely in the nature of red tape. In the ordinary course of operation these regulations are politely ignored by officials and public alike.

It has been an amusing spectacle to see the men hard at work weighing every ounce of coal, carefully brushing all the seats in the carriage, while anxious and indignant passengers fume outside the cars; weighing and measuring every piece of baggage, and otherwise observing red tape precaution of the rules.

The John Fritz Medal.

The first award of the John Fritz Medal, which was established by the professional associates and friends of John Fritz, of Bethlehem, the old Iron Master, on October 31, 1902, on the occasion of Mr. Fritz's eightieth birthday, has been made to Lord Kelvin for "cable telegraphy and other general scientific achievements." The award was made by the following board selected for the purpose: From the membership of the American Society of Civil Engineers: Robert Moore, Alfred Noble, Chas. Warren Hunt, Chas. Hermany. From the membership of the American Institute of Mining Engineers: E. G. Spilsbury, James Douglas, Charles Kirchoff, E. E. Olcott. From the membership of the American Society of Mechanical Engineers: John E. Sweet, Robert W. Hunt, Samuel T. Wellman, James M. Dodge. From the membership of the American Institute of Electrical Engineers: Carl Hering, Charles P. Steinmetz, Charles F. Scott, B. J. Arnold.

Crocker-Wheeler Benefit Association.

The Crocker-Wheeler Company announces that the shop employees at Ampere, N. J., have organized a beneficial association on the following basis:

Every employee who pays ten cents a week to the association will be entitled to $10 a week, for 20 weeks, during incapacity through illness. If he dies, his family will receive $100. The payment of twenty, thirty or forty cents a week entitles him to $15, $20 or $25, respectively, with death benefits of $150, $200 or $250.

The company has offered to contribute an amount equal to the dues paid to the association. Thus, if $6,000 is paid yearly in dues, the income of the association will be $12,000. The company does not require representation in the association, which will be run entirely by the employees.

Surprise Checking on the Queen & Crescent.

The Cincinnati, New Orleans & Texas Pacific now has surprise tests of its enginemen, to see how well they obey the rules regarding the observance of signals, etc. The trainmen and conductors are also tested in the matter of train protection. The circular issued at the time the tests were begun reminds the men that they are not to rely on "customary practice," but must follow the printed rules to the letter. The *Cincinnati Commercial Tribune*, which prints this news, says that the enginemen were shown the records of surprise tests which had been made on another road, presumably the Chicago & North Western, and were enjoined to see that the results on their own road proved equally satisfactory. A train-rule examiner has been appointed on each division of the C., N. O. & T. P., and an order has been given to have the legend "SAFETY BEFORE SPEED" stenciled in all the locomotive cabs.

Mashonaland Railways.

The Mashonaland Railway Company now controls the lines extending from the Port of Beira, on the East Coast of Africa, to Kalomo, a township on the Central African Plateau, about 90 miles north of the Zambesi. The company is about to spend $13,000,000 in building 250 miles of railroad from Kalomo to the Broken Hill Mine in Rhodesia, and in buying and widening the gage of the line from Salisbury to the Ayrshire mine, 84 miles; also on the extension of the Salisbury-Ayrshire line to the Eldorado mine, the center of the Rhodesian Banket Reef formation, 14 miles. On the line which is now being built from the Zambesi to Kalomo, 90 miles, 60 miles of grade has been finished, and 30 miles ballasted. It is expected that the rails will reach Kalomo in July. If they do, the extension to the Broken Hill mine is to be completed in July, 1906. English financiers and investors were being invited early in March to supply the money necessary for these undertakings.

Air Openings Under Locomotive Grates.

There has been considerable discussion on this question recently and especially before the Northwestern Railway Club, where it was stated that the damper openings in recently built locomotives have been gradually reduced, and the space for damper openings is scarce on some of the latest locomotives; while on the little old engines of the past it was ample. As there is a direct loss of heat when the air supply is not adequate, sometimes reaching 25 per cent., it shows that the ash-pan subject is one that should not be forgotten in designing a new locomotive, or improving one which is in service, and it is safe to say that a large saving in fuel can be accomplished by increasing the damper openings in our recently-built locomotives.

For perfect combustion it requires 8 pounds of oxygen for every pound of hydrogen and 2⅔ pounds of oxygen for every pound of carbon. With the dampers of a modern locomotive contracted, how is perfect combustion to be attained? By staying the firebox with hollow stays with an inside diameter of ⅛ inch and not over 3-16 inch. You cannot get sufficient air through the grates and you dare not have the air in excessive volumes over the fire-bed, but to the extent that you can get air through 1,000 or more hollow staybolts with ⅛-inch holes, whether sufficient or not for perfect combustion, you will have enough oxygen by its union with the combustible gases in the firebox to pay for the hollow staybolts several times over. As the air passes through the hollow staybolts the risk of burning is decreased, expansion of the bolt is lessened and the cracking of the sheets from antagonism is decreased. Furthermore the exhaust of the locomotive drawing a current of air through the hollow bolts keeps the hole open and thereby presents a double opportunity for detection of breakage, both inside as well as outside of the firebox.

Renumbering Pennsylvania Freight Cars.

The freight cars of the Pennsylvania Lines, both east and west of Pittsburg, are now being all renumbered and will hereafter be grouped according to classes and capacity in such a way that agents, clerks and conductors anywhere on the system will be able at sight of the number of a car to tell what kind it is and how much it will carry. The cars belonging east of Pittsburg will bear numbers from 10,001 to 500,000, and those west of Pittsburg from 500,001 to 999,999.

The numbers from 1 to 10,000, inclusive, will be reserved for passenger-train cars on the lines east of Pittsburg. The plan, which was under consideration several years ago, of assigning groups of numbers to the different roads in the system, as, for example, 550,001 to 575,000 to the Cleveland & Pittsburg, appears to have been rejected; so that all cars of the same kind and capacity—as, for example, 20-ton cattle cars—will now be in the same group of numbers whether they belong to the West Jersey & Seashore or to the Indianapolis & Vincennes or to any other road belonging to the Pennsylvania System. The Vandalia Railroad and the Grand Rapids & Indiana are not included in the scheme. The standard box cars of 100,000 lbs. capacity will be put in the first group, so that as the lighter cars are worn out or destroyed and their numbers become vacant, the new cars taking the places of the old will naturally fall into the lowest numbered groups. As there are at present no numbers above 200,000, the renumbering west of Pittsburg will be an easy matter; but east of Pittsburg, the task of changing the numbers without having any duplicates in service will be one of considerable magnitude.

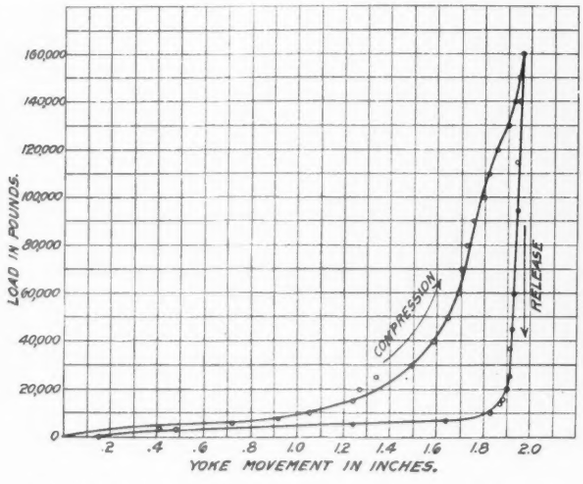
Prizes Offered by the Engineering News.

The Engineering News Publishing Company offers two prizes, amounting in the aggregate to $350 for the two best papers on the "Manufacturing of Concrete Blocks and Their Use in Building Construction." The company calls attention to the fact that this is a subject of great importance to all technical men and one about which comparatively little is known on account of its newness. It is hoped that the competition thus instituted will be of great benefit to the engineering and architectural profession by making public the results of experiments in research. The author whose paper is judged to be the best will receive a prize of $250. The author whose paper is second in rank will receive a prize of $100; and the merits of the papers will be judged chiefly from the standpoint of their practical usefulness to the engineer who proposes to establish a local business and manufacture concrete blocks. The length of the paper should not be less than 5,000 and not more than 10,000 words. It may be accompanied by any drawings or photographs which the author deems necessary for its illustration. All manuscript must be typewritten and must be received at the New York office of the Engineering News Publishing Company not later than July 31, 1905. Of the entire amount paid in prizes, $225 will be paid by the Engineering News Publishing Company, which instituted the competition, and $125 by the publishers of the *Cement Age*. Further particulars can be obtained from the Engineering News Publishing Company, 220 Broadway, New York.

The Harvey Draft Spring.

A draft spring designed to be interchangeable with the standard M. C. B. spring, but imposing a normal resistance to loads varying from 1 lb. to 150,000 lbs., has been patented by George L. Harvey, Chicago. Its construction is shown by the accompanying elevation and cross-sections, showing three different positions in service. There are two springs or coils, which are non-concentric, the outer one being slightly elliptical. As the device closes, this ellipse changes to a circle. This provision, it is claimed, prevents undue unwinding and set in this coil. The relation of the two coils is such as to impart to the device the characteristics of a friction gear. Up to 17,200 lbs. it acts as a simple coil spring, with a motion of ⅞ in. From this point up to 150,000 lbs. the friction surfaces are in action, the inner coil closing at this load, with a total travel of 1⅞ in. The elliptical form of the outer coil permits the friction to act earlier and also more gradually than if both coils were circular. The sectional views show the relation of the two coils at the three stages mentioned above.

A diagram of a static compression test made at Purdue University by Prof. W. K. Hatt is shown herewith. The point of closure was 160,000 lbs., the compression line being a uniform curve without undue wave. On the release curve the very slight travel down to 20,000 lbs. will be noted, the distance being approximately $^1/_{16}$ in. One of the chief advantages of the device is its extreme simplicity and the fact that it may be interchanged with the ordinary M. C. B. 6¼-in. x 8-in. draft spring. Where it is substituted for other devices, special followers are furnished. The device is practically indestructible under the heaviest loads, a test load of 375,000 lbs. on a Riehle machine having failed to affect it injuriously in any way. The Detroit Steel Products Co., Detroit, Mich., is the sole maker of the device, and the Frost Railway Supply Co., Detroit, is sole agent for the United States.



Static Compression Test, Harvey Friction Draft Spring.

Harvey Friction Spring.

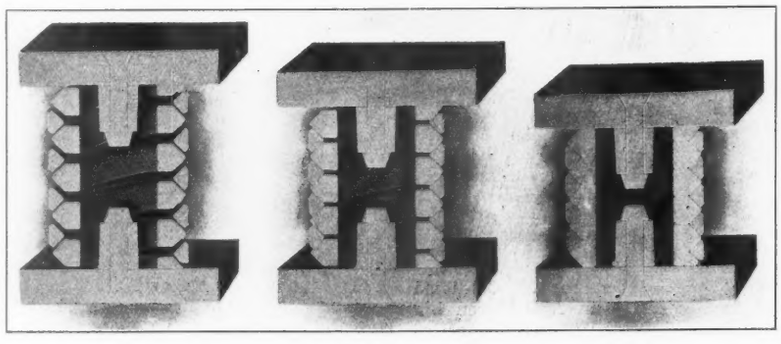


Fig. 1. Fig. 2. Fig. 3.

A Bit of History.

A Hoboken real estate agent, acting for the North River Bridge Company, has sold a piece of property at the corner of Garden and Twelfth streets, Hoboken, to William A. Ebson, for $7,000. The company has disposed of all the land which it bought in Hoboken for bridge purposes excepting a plot 15x20 feet, adjoining the Ebson property. It is said that this plot will be retained to preserve the company's charter. The company originally planned to span the river with a bridge over which the railroads would run trains to New York. The bridge scheme was killed by the various tunnel plans.

Trolley Hoists in the Interborough Shops.

One of the interesting features of the inspection shed and repair shop, recently completed for the New York Subway at Seventh avenue and 148th street, is the overhead conveying system installed. This consists of an electric traveling hoist and an overhead track which connects the different buildings. The space covered is practically an entire block, the blacksmith and paint shops at the north end being separated from the main building by an electrically operated transfer table. This overhead electric system, sometimes called telpherage, was installed for the rapid conveyance of machinery and tools to any part of the shops without interference with the work done on the floor.

The track is a 15-in. I-beam bolted to the under side of the roof truss. It runs the entire length of the north and south bays of the inspection shops, crossing the middle bay at either end. Branch tracks, supported by steel trusses, extend over the transfer table and run the length of the blacksmith and paint shops. Curves, track switches and turntables enable the traveling hoist to reach the elevator in the store room, as well as other parts of the building, where there are special tools. The traveling electric hoist has a capacity of four tons. It has been of great service, during the fitting up of the shop, in installing the machine tools, rotary transformers, motors, and other machinery. Since the shops have been in operation, the hoist has been in constant use, mounting motors on the car trucks, replacing car wheels, taking armatures or any other parts of the cars to the machine tools for repair, etc. The motors on every subway car fitted up in this shop have been put in place by this machine.

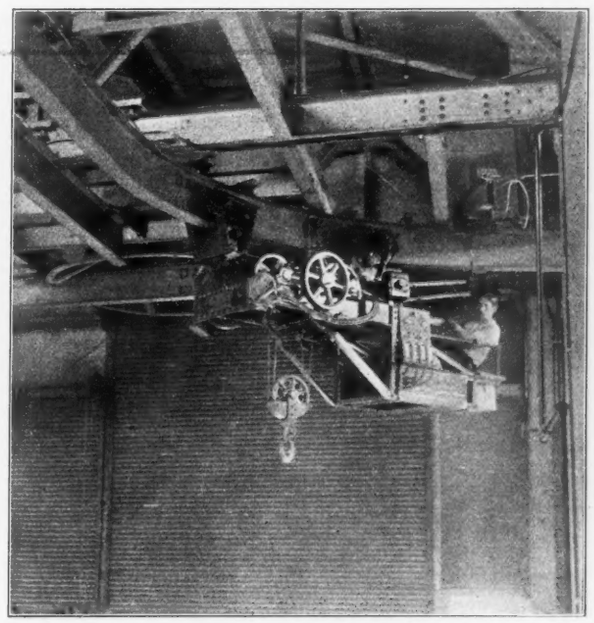


Fig. 1—Hoist Traversing Curve, Showing Turntable.

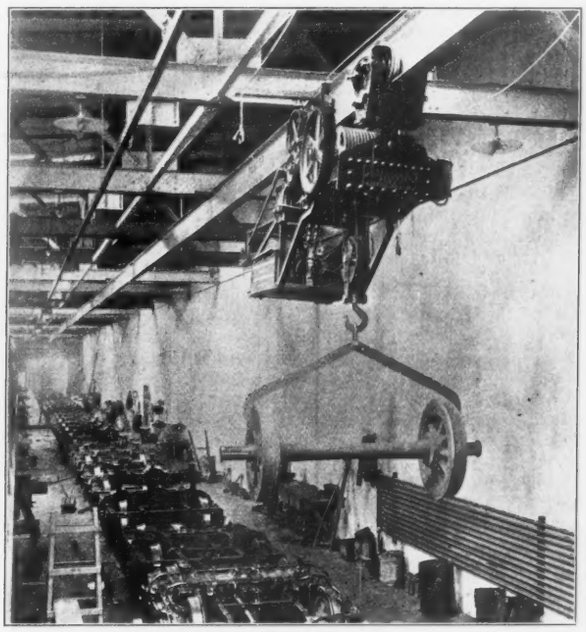


Fig. 2—Hoist in Truck Shop.

Fig. 1 shows the hoist traversing a curve. The turntable is also shown in this photograph. Fig. 2 gives another view of the hoist, carrying a pair of car wheels along a straight section of the track.

The length of the track and the variety of uses for which the hoist is employed make this system of particular interest. No passageways have to be kept open, and no floor space is used; consequently there are no delays in handling any of the machinery or in transferring materials from one building to another.

Mr. J. Van Vleck and Mr. W. C. Phelps, of the Interborough Company, assisted by Mr. R. A. Byrns, of the New York office of the Northern Engineering Works, designed the layout. The entire system was built and installed by the Northern Engineering Works, Detroit, Mich.

Manufacturing and Business.

The Connellsville (Pa.) Machine & Car Co. has decided to rebuild and enlarge the shops recently damaged by fire. The company makes pumps, mine cars and other mining and working machinery.

The E. E. Naugle Tie Co., Chicago, has moved from 159 La Salle street to the Mallers Building, 226-228 La Salle street, and is occupying the entire ninth floor. The company supplies railroads with ties, telephone poles and fence posts.

Mr. W. A. Stadelman, for ten years General Eastern Agent of the Brown Hoisting Machinery Company, has been appointed General Eastern Agent of the Wellman-Seaver-Morgan Company, of Cleveland, with offices at 42 Broadway, New York, effective April 1.

The Panama Canal Commission closed a contract with the Ingersoll-Sergeant Drill Company, of New York, for 50 standard rock drills, complete with mountings and equipment. These machines are to be used in the removal of rock in the great Culebra cut through the crest of the Isthmus.

The Norfolk Railway & Light Co., of Norfolk, Va., will put all of its feed and arc light wires underground. The Standard Vitrified Conduit Co., 39 Cortlandt street, New York, has secured the entire order for the 300,000 ft. of vitrified conduit which will be required.

The National Electric Co., Milwaukee, Wis., maker of Christensen air-brakes and of electrical machinery, has moved its general sales office of the electrical department from Milwaukee to Chicago, and has enlarged its quarters in the Old Colony Building in consequence.

The Allis-Chalmers Company is removing its general offices from Chicago to Milwaukee. All of the several departments will be located there in the future. Plans for the shop extension at West Allis are completed and a number of additions to the company's large works will soon be begun.

The contract for building the first group of buildings for the Carnegie Technical School in Pittsburg has been given to the Wells Bros. Co., of New York, at $499,700. There were several other bids. This does not include the plumbing, heating and lighting, for which contracts will be awarded later.

Messrs. A. C. Bunker and W. C. Appleton have become associated with the Crocker-Wheeler Company, Ampere, N. J., in the engineering and contract departments, respectively. This company took up the design and manufacture of alternating current machinery only eight months ago, but the rapid increase in this new branch of its business has necessitated a corresponding enlargement of its engineering staff.

A new company, to be called the Goodspeed Engine & Valve Co., of Minneapolis, is being formed by capitalists of that place with a capital of $1,000,000 under the laws of Minnesota, and is planning to put up large works at Minneapolis to make steam engines. Rufus L. Hardy, of Minneapolis, is said to be interested.

A contract has been given to Charles A. Fellows, of Topeka, Kan., by the Atchison, Topeka & Santa Fe, for the superstructure of the $400,000 elevator which that road is building at Turner, near Kansas City. The contract for the foundation had been previously awarded to Mr. Fellows, and work has been in progress for the past few weeks.

The Wellman-Seaver-Morgan Company, with main office and works at Cleveland, Ohio, announces that Geo. B. Damon, who has been manager of their New York office, has been transferred to the engineering and sales department at Cleveland, Ohio, and that Mr. W. A. Stadelman, for the past ten years manager of the eastern office of The Brown Hoisting Machinery Company, has become the manager of the general eastern office of The Wellman-Seaver-Morgan Company, with offices at 42 Broadway, New York City.

Iron and Steel.

The Pennsylvania Steel Co. and the Maryland Steel Co. have orders for over 60,000

tons of rails for railroads in Argentina.

At a recent meeting of the Isthmian Canal Commission, it was decided to at once buy 2,500 tons of steel rails.

PERSONAL.

—Mr. Isaac L. Requa, once President of the Central Pacific Railroad, and also a Director in other Huntington lines, died recently, at the age of 80. He was born at Tarrytown, N. Y., and in the early fifties went to California.

—Mr. Charles L. Gist, Superintendent of Transportation of the Pittsburg & Lake Erie, died suudenly on April 2, at the age of 45. Mr. Gist began railroad service on the Marietta & Cincinnati, in 1874, and was for some time on the Pennsylvania Lines West of Pittsburg.

—Mr. George H. Colket, President of the Huntington & Broad Top Mountain, died suddenly at his home in Philadelphia, on March 29, at the age of 62. Mr. Colket was graduated from the University of Pennsylvania in 1862. He was an official of the North American Smelting Company, a Director of the Penn National Bank and of the Germantown & Norristown Railroad.

—Mr. H. B. Spencer, the new General Manager of the Southern Railway, was graduated from Harvard University in 1895, and began railroad service as clerk in the office of the Superintendent of the Elgin, Joliet & Eastern, at Joliet. In 1897 he went to the Alabama Great Southern as Assistant Superintendent, at Birmingham. The next year he went to the Southern as Superintendent of the Louisville Division, at Louisville. He remained in that position but a short time when he was promoted to be Assistant General Manager of the St. Louis-Louisville Lines, at St. Louis, later being made General Manager, from which position he is now promoted to that of General Manager of the system.

—Mr. Thomas Carr Powell, the new Fifth Vice-President of the Southern Railway, was born at Cincinnati, Ohio, in 1865. He entered railroad service in 1884, as clerk on the Cincinnati, New Orleans & Texas Pacific, and served that company in the traffic department until 1893, when he was appointed Assistant General Freight Agent. In 1895 he went to the Southern, in a clerical position. He was later promoted to be General Freight Agent of the company and the Northern Alabama. In 1899 he was made Assistant Freight Traffic Manager, and three years later became Freight Traffic Manager, from which position he is now promoted to the Fifth Vice-Presidency, in charge of traffic in the West and of the Operating Departments of the St. Louis-Louisville Lines.

—Mr. Ralph Peters, who on Wednesday of this week was chosen to succeed Mr. Potter as President of the Long Island Railroad, has for 3 years been General Superintendent of the Pittsburg, Cincinnati, Chicago & St. Louis. He was born in Atlanta, Ga., in 1853, and is a graduate of the University of Georgia, class of 1872. In that year he became Superintendent of the Atlanta Street road, at Atlanta. Two years later he went to the Pennsylvania Lines as Secretary and Chief Clerk to the General Superintendent. Then for a few months he was Superintendent of the Western Division of the Columbus, Chicago & Indiana Central (P. C. C. & St. L.), and in June, 1881, was appointed Superintendent at Cincinnati. He held this office for about 20 years, and from 1896 was General Agent also. He was an officer in a number of subsidiary companies. He was appointed General Superintendent of the Southwest System in June, 1901.

ELECTIONS AND APPOINTMENTS.

Atlantic Coast Line.—R. E. Smith, hitherto Assistant to the General Manager, has been appointed General Superintendent of Motive Power, with headquarters at Wilmington, N. C. W. H. Newell, hitherto District Superintendent at Norfolk, Va., has been appointed Superintendent of the Charleston District, with headquarters at Charleston, S. C. E. R. Wootten, hitherto District Superintendent of South Rocky Mount, N. C., has been appointed to succeed Mr. Newall at Norfolk, and J. C. Murchison in turn succeeds Mr. Wootten as Superintendent of the Fayetteville District.

Chesapeake & Ohio.—The authority of E. W. Grice, Superintendent of the Huntington Division, has been extended over the Greenbrier Division, succeeding H. Pierce, transferred to the position of Engineer of Construction. J. W. Haynes, now Assistant Superintendent of the Kentucky Division, has been transferred to Ronceverte, W. Va., as Assistant Superintendent of the Greenbrier Division. The office of Assistant Superintendent of Kentucky Division has been abolished.

Chicago Great Western.—A. D. Ward, Purchasing Agent, has resigned.

Cincinnati, Hamilton & Dayton.—W. D. Lowry has been appointed Master Car Builder, with headquarters at Lima, Ohio.

Colorado Springs & Cripple Creek District.—D. C. McWatters has been appointed General Passenger Agent, with headquarters at Colorado Springs.

Denver & Rio Grande.—S. C. Matthews has been appointed Assistant General Auditor.

Erie.—W. J. Sharp has been appointed Superintendent of the Susquehanna and Tioga Divisions, with headquarters at Elmira, N. Y., succeeding W. L. Derr, resigned. (See New York, New Haven & Hartford.)

Fort Worth & Rio Grande.—C. W. Strain has been appointed General Passenger Agent, succeeding W. A. Tuley.

Grand Central Station (New York).—H. S. Balliet has been appointed Engineer of Maintenance of Way of the Grand Central Station and Harlem line (New York Central). Office at Grand Central Station, New York City. Lawrence Griffith, Engineer of Maintenance of Way, has resigned to become an officer of the Federal Railway Signal Company, as heretofore announced in the *Railroad Gazette*.

Great Northern.—G. S. Yerkes has been appointed Assistant General Passenger Agent, with office at Seattle.

C. E. Stone, hitherto Assistant General Passenger Agent, has been appointed General Passenger Agent.

Illinois Central.—F. M. Jones has been appointed Superintendent of the Omaha Division, with headquarters at Fort Dodge, Iowa, succeeding F. S. James, who goes to New Orleans as Superintendent of the Louisiana Division.

Lake Shore & Michigan Southern.—J. W. Daly, General Eastern Agent, has been appointed Chief Assistant General Passenger Agent of this company, and of the Michigan Central, with headquarters at Buffalo, N. Y.

Long Island.—Ralph Peters, hitherto General Superintendent of the Southwest System of the Pennsylvania Lines, at Columbus, Ohio, has been elected President of the Long Island to succeed the late W. F. Potter.

Michigan Central.—W. H. Underwood, General Eastern Passenger Agent, has been appointed Assistant General Passenger Agent, with headquarters at Chicago, succeeding G. E. King, promoted. (See Lake Shore & Michigan Southern.)

Missouri Pacific.—J. M. Walsh has been appointed Superintendent of the Joplin Division, with headquarters at Nevada, Mo. E. F. Kearney has been appointed Superintendent of Terminals at St. Louis. Mr. Kearney will report to the Assistant General Manager. C. F. Jewell has been appointed Inspector of Office and Station Service to investigate and report upon the efficiency of the men and methods employed in such service, with headquarters at St. Louis.

New York, New Haven & Hartford.—W. L. Derr, hitherto Superintendent on the Erie, has been appointed Superintendent of the Hartford Division of the N. Y., N. H. & H., with headquarters at Hartford, Conn., succeeding G. H. Wilson resigned.

Pennsylvania Lines West of Pittsburg.—The following appointments in the Accounting department have been made: A. P. Griest, Auditor of Ore and Coal Freight Receipts; T. B. Stoakes, Assistant Auditor of Ore and Coal Freight Receipts; John B. Britain, First Assistant to the Comptroller; J. W. Orr, Second Assistant to the Comptroller, and John Hurst, General Accountant, all with offices at Pittsburg.

Pittsburg, Cincinnati, Chicago & St. Louis.—Ralph Peters, General Superintendent, has resigned. (See Long Island.)

St. Joseph & Grand Island.—Raymond Du Puy, Vice-President and General Manager, has resigned. It is said that Mr. Du Puy is to take charge of the building of a new line in the east.

St. Louis & San Francisco.—J. H. Elliott, Superintendent of Mails, has been appointed Superintendent of the Third District, with headquarters at Cape Girardeau, Mo.

Southern.—C. H. Ackert, hitherto General Manager, has been appointed Fourth Vice-President, in charge of Operating Departments, with headquarters in Washington; T. C. Powell, hitherto Freight Traffic Manager, has been appointed Fifth Vice-President, in charge of Traffic in the West, and of Operating Departments of the St. Louis-Louisville Lines, with headquarters at St. Louis. H. B. Spencer, hitherto General Manager of the St. Louis-Louisville Lines, has been appointed General Manager of the Eastern and Western Districts, with headquarters at Washington. C. P. Cooper, hitherto Accountant to the General Manager of the St. Louis-Louisville Lines, has been appointed General Superintendent of the S. L.-L. Lines, reporting to the Fifth Vice-President. Mr. Cooper's office will be in St. Louis. Lincoln Green, hitherto General Freight Agent, has been appointed Freight Traffic Manager, with headquarters at Washington. George R. Browder, hitherto Assistant General Freight Agent, has been appointed General Freight Agent, to succeed Mr. Green. Randall Clifton has been appointed Assistant General Freight Agent, with office at Atlanta, Ga., succeeding Mr. Browder. W. H. Paxton has been appointed Assistant General Freight Agent, with headquarters at Atlanta, Ga. I. L. Graves has been appointed Assistant General Freight Agent, with headquarters at Memphis, Tenn., succeeding Mr. Clifton.

S. M. Dolan, Master Mechanic at Atlanta, has been transferred to St. Louis.

Tennessee Central.—W. M. Armistead has been appointed Master of Terminals in Nashville.

Wheeling & Lake Erie.—H. W. McMaster has been appointed Superintendent, with headquarters at Canton, Ohio.

LOCOMOTIVE BUILDING.

The Grand Rapids & Indiana has ordered 10 freight locomotives from the American Locomotive Co.

The Russian Government is reported to have ordered 270 locomotives from the St. Etienne (France) Iron Works.

The Illinois, Iowa & Minnesota is reported to have ordered two locomotives from the Brooks Works of the American Locomotive Co.

The Minneapolis, St. Paul & Sault Ste. Ma-

rie has ordered six locomotives from the Schenectady Works of the American Locomotive Co.

The Bangor & Aroostook is reported to have ordered two additional locomotives from the Manchester Works of the American Locomotive Co.

The Baltimore & Ohio, under date of April 1, denies the report that it has placed orders for 250 locomotives, for which it has been in the market.

The Norfolk & Western has ordered 17 locomotives from the American Locomotive Co., and nine locomotives from the Baldwin Works. These locomotives are the same type as the nine locomotives ordered from the American Locomotive Co., and the nine from the Baldwin Works, specifications for which were published in our issue of February 24.

The Erie has ordered 50 simple consolidation (2-8-0) locomotives from the American Locomotive Co., in addition to the 50 recently reported. These locomotives will weigh 200,700 lbs., with 176,400 lbs. on the drivers; cylinders, 22 in. x 32 in.; diameter of drivers, 62 in.; straight top boiler, with a working steam pressure of 200 lbs.; heating surface, 3,358 sq. ft.; 380 charcoal iron tubes, 2 in. in diameter and 16 ft. long; Otis steel firebox, 104 in. long and 75 in. wide; grate area, 54 sq. ft.; tank capacity, 7,000 gallons, and coal capacity, 14 tons.

The Mobile & Ohio has ordered 10 simple 10-wheel (4-6-0) and five simple switching (0-6-0) locomotives from the Baldwin Locomotive Works, for July delivery. The 10 wheel locomotives will weigh 170,000 lbs., with 125,000 lbs. on the drivers; cylinders, 21 in. x 28 in.; diameter of drivers, 62 in.; wagon top boiler, with a working steam pressure of 200 lbs.; heating surface, 2,944 sq. ft.; 361 Detroit Seamless Steel Tube Co.'s tubes, 2 in. in diameter and 15 ft. long; firebox 120 3-16 in. x 41⅛ in.; grate area 34.3 sq. ft.; tank capacity, 7,000 gallons, and coal capacity, 15 tons. The switching locomotives will weigh 138,000 lbs.; cylinders, 20 in. x 26 in.; diameter of drivers, 50 in.; straight top boiler, with a working steam pressure of 200 lbs.; heating surface, 1,919.2 sq. ft.; 325 Detroit Seamless Steel Tube Co.'s tubes, 2 in. in diameter and 10 ft. 5 in. long; firebox, 108$^{3}/_{16}$ in. long and 41⅛ in. wide; grate area, 30.8 sq. ft.; tank capacity, 5,000 gallons, and coal capacity, five tons. The special equipment for both will include: Westinghouse-American airbrakes, Western bell ringers, Johns-Manville Boiler Lagging Co.'s boiler lagging, Damascus brake-beams, American and Streeter brake-shoes, Gould couplers, Pyle-National electric headlights for 10-wheel locomotives, Ohio injectors, Ajax journal bearings, U. S. metallic piston and valve rod packings, Consolidated safety valves, Mudd sanding devices, Chicago sight-feed lubricators, Pittsburg Spring & Steel Co.'s springs, Ashcroft steam gages, and Latrobe driving, truck and tender wheel tires. Other specialties are: Hennessey friction draft gear, American Steel Foundries bolsters, Symington oil boxes, Ewald Iron Co.'s staybolts and Reflex water gage.

CAR BUILDING.

The Maine Central has ordered six coaches from the Pullman Company.

The Toledo, Peoria & Western has ordered 50 freight cars from the Pullman Company.

The Chicago Consolidated Traction is reported to have ordered 60 cars from the St. Louis Car Co.

The Lake Superior & Ishpeming is reported to have ordered 150 steel ore cars for early delivery.

The Boyne City & Southeastern has ordered 40 flat cars from the Western Steel Car & Foundry Co.

The Central Vermont has ordered 10 coaches from the Wilmington Works of the American Car & Foundry Co.

Barnes & Tucker are reported to have ordered 300 freight cars from the McKees Rocks Works of the Pressed Steel Car Co.

The Pennsylvania & Mahoning Traction is reported to have ordered a number of cars from the Niles Car & Mfg. Co., of Niles, Ohio.

The New York Central & Hudson River has ordered 200 flat cars of 80,000 lbs. capacity from Haskell & Barker for June delivery.

The Russian Government is reported to have ordered 2,000 cars for the Trans-Siberian Railroad, from the St. Etienne (France) Iron Works.

The Great Northern has ordered 56 passenger cars, the order being divided between Barney & Smith, the American Car & Foundry Co. and the Pullman Co.

The Cleveland, Cincinnati, Chicago & St. Louis has ordered 2,000 box cars of 80,000 lbs. capacity from Haskell & Barker for delivery from July to November.

The Chicago City Railway is reported to have ordered 200 street cars, the order to be divided between the Elizabeth, N. J., Cleveland, St. Louis and Chicago Works of the J. G. Brill Co.

The Atlantic & North Carolina has ordered 50 34-ft. ventilated box-cars, 10 flat and 10 gondola cars, all of 60,000 lbs. capacity, from the South Atlantic Car & Manufacturing Co., and six coaches and three express cars from Harlan & Hollingsworth.

The Detroit & Mackinac is reported to have ordered from Barney & Smith one cafe car, one parlor car, two coaches, one smoking car, 10 excursion cars, one mail and baggage and express car, one baggage car, 25 furniture cars, 25 double-deck stock cars, 50 single-deck stock cars, 100 gondolas and 200 box cars.

The Chicago, Milwaukee & St. Paul is building 200 ore cars of 100,000 tons capacity and will, it is reported, also build 500 stock cars at its Milwaukee shops. The ore cars are to weigh 28,700 lbs., and measure 27 ft. 4¼ in. long, 8 ft. 3½ in. wide and 9 ft. 7 in. high. The special equipment will include Monarch brake beams, Congdon brake shoes and Barber trucks.

The Norfolk & Western has ordered 1,500 drop-bottom gondolas of 100,000 lbs. capacity, and 500 box cars of 80,000 lbs. capacity, as reported in our issue of February 24, from the Pressed Steel Car Co.; also 1,000 hopper cars of 100,000 lbs. capacity and 500 box-cars of 80,000 lbs. capacity from the American Car & Foundry Co.; and 1,000 hopper cars of 100,000 lbs. capacity from the South Baltimore Steel Car & Foundry Co. The drop bottom gondolas are to weigh 39,200 lbs., and measure 40 ft. long, 9 ft. 11 in. wide and 8 ft. $2^{7}/_{16}$ in. high from rail. The box-cars will weigh 38,700 lbs. and measure 38 ft. 3 in. long, 9 ft. 11½ in. wide and 13 ft. 1½ in. high. All hopper cars are to weigh 38,000 lbs., and measure 33 ft. ½ in. long, 9 ft. 4½ in. wide and 10 ft. ⅞ in. high. Special equipment for all will include Westinghouse air brakes, Ajax brasses, Butler draft rigging and Barber trucks.

The Western Maryland has ordered 700 gondola cars and 300 box cars of 80,000 lbs. capacity from the American Car & Foundry Co.; 200 box cars, 50 flat cars of 80,000 lbs. capacity, and 50 open stock cars of 60,000 lbs. capacity, from the South Baltimore Steel Car & Foundry Co., and 500 steel hopper cars of 100,000 lbs. capacity from the Cambria Steel Co., all for fall delivery. The gondolas will be 40 ft. 10 in. long, 8 ft. 11 in. wide and 3 ft. 4 in. high, all inside measurements. All box cars will be 36 ft. long, 8 ft. 6 in. wide and 8 ft. high. The flat cars will be 40 ft. 2 in. long and 9 ft. 3 in. wide over floor. The stock cars will be 36 ft. 1 in. long, 8 ft. 6 in. wide and 7 ft. high, all inside measurements. The hopper cars will weigh approximately 39,000 lbs. and measure 31 ft. long and 9 ft. 6 in. wide inside, and 10 ft. high from rail to top. The special equipment for all is to include Cambria Steel Company's axles and Benjamin Atha Company's bolsters; for hopper cars American Steel Foundry's bolsters; for other cars Simplex brake beams, American Brake Shoe & Foundry Company's brake shoes, Westinghouse air brakes, Damascus brasses, Gould couplers, Jones doors for box cars, Farlow draft rigging for stock cars, Miner tandem draft rigging for other cars, McCord journal boxes and lids, Protectus Company's paints for all cars but stock cars, Union Spring & Mfg. Co.'s springs, Barber trucks and American Car & Foundry Company's wheels for 300 Lox cars and gondola cars, and Maryland Car Wheel Company's wheels for 200 box cars, 50 flat cars and 50 stock cars.

BRIDGE BUILDING.

CEDAR RAPIDS, IOWA.—The City Council has given the contract for the Second avenue bridge to the Marsh Bridge Co., of Des Moines, at $82,100. The bridge is to be a Melan arch.

CLEVELAND, OHIO.—The Newburg section ordinance calls for the completion of the following bridge work within two years, at an estimated cost of $825,000, of which the city will pay $234,000: At Woodland Hills avenue, a bridge 84 ft. long; at Broadway, a bridge 60 ft. long; a bridge over the tracks at Warner road 84 ft. long, and at Harvard street, a 60-ft. bridge.

CLINTON, IND.—The Southern Indiana is putting up a bridge 15 miles northwest of this city, over Jenkins ford, which will be 118 ft. above the water and 1,680 ft. long, to carry two tracks.

DES MOINES, IOWA.—The contract for building two Melan arch approaches to the Sixth avenue bridge has been given to John Dean & Co., of Chicago, the lowest bidders, at $26,200.

GALVESTON, TEX.—The Gulf, Colorado & Santa Fe, it is reported, has given a contract to Kahman & McMurray, of Kansas City, Mo., for the superstructure of its proposed bridge to be built over the Sabine river on the Jasper & Eastern Railroad.

NEW HAVEN, CONN.—Bids are wanted by the City Engineer April 10 for building a concrete bridge 75 ft. long and 67 ft. wide, and approaches on Kimberly avenue, over West River.

NEW YORK, N. Y.—Separate bids are wanted April 11 by Geo. E. Best, Commissioner of Bridges, for the partial reconstruction of the Manhattan Terminal of the Brooklyn Bridge, and for building the University Heights bridge and approaches over the Harlem river, from 207th street, Manhattan, to 184th street, Bronx.

PASCO, WASH.—The Northern Pacific, local reports state, has decided to build a new steel bridge over the Columbia River to replace the present structure, and will also put up about 20 others on the Washington & Idaho division.

PORTSMOUTH, VA.—The Seaboard Air Line will put up, during the coming year, steel bridges as follows: Over Blackwater river, near Franklin, Va., 143 ft. truss span; over Roanoke river, near Weldon, N. C., eight deck lattice spans 80 ft. long; over the Southern Railway, at Columbia, S. C., seven girder spans at various streets, each 52 ft. long; over Trout creek, near Jacksonville, Fla., a new draw span; over Ocklocknee river, near Gretna, Fla., a new truss span 143 ft. long; over Suwanee river, near Ellaville, Fla., two truss spans each 152 ft. long. The bridge over the Savannah river near Garnett, S. C., will be rebuilt.

PURDAY, WASH.—Bids are wanted April 21 by I. M. Howell, County Auditor, for building bridges and pile trestle approaches over an arm of Henderson Bay, in Pierce County.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ATCHISON, TOPEKA & SANTA FE.—Contracts have recently been given by this company for about 130 miles out of the total of 152 miles of the double tracking along the line of its road which it expects to carry out this year. The contracts let are for the work between Kernan and Streator, Ill., to Haines & Co., of Shorey, Kan.; between Florence and Peabody, Kan., to Likes & Hatfield, of Wichita, Kan.; between Bucklin and Marceline, Mo., to Pettibone, Sentry & Co., of

Chicago. Three contracts were given to Cameron, McManus & Joyce, of Keokuk, Iowa, which includes the grading between Streator and Macuta, Iowa, and Hardin and Lexington, Mo. The Lantry-Sharp Contracting Co. will do the work on the line between Macuta and Nixon, Mo.; Zarah and Olathe, Kan., and "H U" Tower and Malvern, Kan., and Olivet and Lebo, Kan. The two most important contracts are yet to be let. They are on that section of the road between Peabody and Leaman, and Malvern and Olivet, Kan., where the line is to be straightened.

This company, it is reported, is planning to connect its line in New Mexico with the Texas system by building from Amarillo or Canyon City, on the Pecos Valley, to Brownwood, Texas.

ATHABASCA NORTHERN.—The railway committee has passed an act incorporating this company, with a capital of $2,000,000, to build a road from Edmonton to Athabasca, 96 miles. F. H. Markey, Montreal, and others, are incorporators.

ATLANTIC COAST LINE.—A contract has been given to W. T. Carter for building a freight yard about two miles long between the large transfer sheds at Jacksonville, Fla., and Grand Crossing. The work calls for the removal of 60,000 cu. ft. of soil and the laying of 12 miles of tracks in the yard, besides the building of a roundhouse.

BALTIMORE & OHIO.—The new line of this company between Niles and Ravenna, Ohio, was recently opened. It is about 25 miles long, five miles shorter than the old line between these points, and is a part of about 70 miles of the old Pittsburg & Western, which the Baltimore & Ohio started to rebuild about two years ago. Several miles east and west of New Castle have already been finished and put into service. The new Niles-Ravenna line will be used jointly by the Baltimore & Ohio and the Pennsylvania, the latter purposing to make it a link in the new short route between Pittsburg and Cleveland.

This company, it is reported, is planning to make terminal improvements at Cleveland, costing approximately $1,000,000. Two new ore-loading machines will be put up at a cost of about $250,000, and 12 or more new tracks will be laid from a point near the Superior street viaduct to the Lake Shore and the Cleveland & Pittsburg tracks. Part of the line will be elevated.

BALTIMORE & OHIO SOUTHWESTERN.—Reports from Cincinnati say that this company will spend about $500,000 in improving its facilities in that city. A second track will be laid between Madeira and O'Bannon, 10 miles.

CAPE FEAR & NORTHERN.—Arrangements are reported completed for at once beginning work on an extension of this road. The road now runs from Apex, on the Seaboard Air Line, to Dunn, on the Atlantic Coast Line, and from Apex to Durham, about 21 miles, giving a connection with the Southern and the Norfolk & Western. It is also stated that the road will be extended southeast from Dunn to Southport, at the mouth of the Cape Fear river.

CHICAGO & ALTON.—An officer writes that this company has let a contract for six miles of second track work between Mazonia and Pequot, Ill. The grading is light.

CHICAGO, MILWAUKEE & ST. PAUL.—Official announcemnt is made that this company has decided to build an extension from Chamberlain, S. Dak., west to Lyman County, opening up a new region of land rich in agricultural resources. This extension will be built under the name of the White River Valley, recently incorporated in South Dakota.

CHICAGO, WISCONSIN & SOUTH DAKOTA.—Incorporation has been asked in South Dakota by this company, with a capital of $1,000,000, to build a road from Viroqua, Wis., to Pierre, S. Dak., 767 miles. The incorporators include A. S. Hendricks, of Chicago, and L. L. Stephens and F. A. Stephens, of Pierre, S. Dak.

DELAWARE, LACKAWANNA & WESTERN.—Plans are being made for building an additional track from the station in Scranton, Pa., east to the end of the third track at Nay Aug, five miles. The work includes the widening of the tunnel at the latter place to accommodate four tracks.

DENISON & NORTHERN.—Surveys, it is reported, are being made, which are said to be in the interest of this road, for a line to be built from Colegate and Lehigh, Ind. T., via Davis to Lawton, Okla. T., 125 miles, with east and west lines through the coal fields of the Chickasha Nation, Ind. T., and in Comanche County, Okla. T. The Colegate Company, which has large interests at Lehigh and Colegate, is believed to be the promoter of this road. This company controls the right of way and the old grade of the Denison & Northern, which completed surveys to Mill Creek last summer. Philadelphia capitalists are also said to be interested in the enterprise.

FOURCHE RIVER VALLEY & INDIAN TERRITORY.—An officer writes that this company, which has been granted a charter in Arkansas to build a steam road from a point on the Choctaw, Oklahoma & Gulf near Esau, in Perry County, to a point on the line between Perry and Yell counties, has track laid for nine miles. The work is being done by the company's men and no contracts will be awarded. The road will open up a new country and will be used principally for hauling timber. F. H. Hartshorne, Esau, Ark., is President. (March 24, p. 89.)

FOX RIVER VALLEY (ELECTRIC).—An incorporator writes that this company has been chartered in Wisconsin with a capital of $25,000 to build an electric road from Sheboygan to Manitowoc. Work will be commenced about May 1. The incorporators are: O. H. Behnke, Manitowoc, Wis.; Henry Beyersdorf and Fred Beyersdorf, Milwaukee, and L. A. Bazlen, Calumet County.

GRAND RAPIDS & KALAMAZOO VALLEY (ELECTRIC).—This company has let contracts for building and equipping its line. The Westinghouse Company has been given the contract for the electrical equipment. The road is to be 60 miles long and to cost about $1,500,000.

GREAT NORTHERN.—This company, according to reports, is making surveys for an extension from Turner, in McHenry county, northwest to Renville, about 50 miles. The proposed extension will open up one of the most fertile sections of North Dakota.

Surveys, it is reported, are being made by this company for a new line to be built from Arispe, Iowa, through Creston, Greenfield and Guthrie Center to Sioux City.

HARTFORD, MIDDLETOWN & NEW HAVEN.—Application has been made to the Connecticut Legislature for authority to build an electric road from the terminus of the Hartford Street Railway in Wethersfield through Rocky Hill, Cromwell, Middletown, Middlefield and Durham to the lines of the Consolidated Railway Co. at Montowese, about 35 miles. Louis D. Parker and G. C. F. Williams, of Hartford, and Frank D. Haines, of Middletown, are interested in this project.

HARTFORD & MIDDLETOWN TRAMWAY.—Application has been made by this company for incorporation in Connecticut, with a capital of $1,000,000, to build an electric line from the end of Franklin avenue, Hartford, through Weathersfield, Rocky Hill and Cromwell to Middletown.

HOOD RIVER.—This company, it is reported, has given a contract to Archie Mason and Giebisch & Joplin, general contractors, to grade 16 miles of roadbed and begin track laying. The proposed route is along the east bank of Hood river in Oregon, passing through a rich timber region. The work includes one tunnel 300 ft. long, several trestles and some rock work.

HOUSTON-GALVESTON (ELECTRIC). — This company has been incorporated in Texas with a capital of $1,350,000 to build an electric road between these two points, about 50 miles. F. P. Read, R. M. Johnson, G. L. Horton and A. D. Trotter are incorporators.

IOWA CITY & EASTERN (ELECTRIC).—Under this name the Cedar Rapids & Iowa City, which last year completed 23 miles of its road between Cedar Rapids and Iowa City, proposes to build an extension from the latter point to Muscatine, Iowa, 39 miles.

JACKSONVILLE & SOUTHWESTERN (ATLANTIC COAST LINE).—This company, which will build an extension from Newberry to Perry, Fla., 75 miles, has given a contract to A. F. Langford, of Valdosta, Ga., who expects Northern, to the south shore of Red Lake, 35 miles, 10 miles of which were built some years ago by the Red Lake Transportation Co., is all under contract to H. K. Halvorson to have the work completed by the first of September. The work includes the building of a bridge over the Suwanee river. Surveys have also been made from Perry towards River Junction in West Florida, and the road when completed will probably be used as a cut-off for the Atlantic Coast Line down the west coast of Florida.

LOUISVILLE & NASHVILLE.—Contracts are about to be let by this road for some heavy grading on its line between Corbin, Ky., and Jellico. The work includes 11 miles of new road.

MINNEAPOLIS, RED LAKE & MANITOBA.—An officer writes that this road, which runs almost due north from Bemidji, on the Great & Co. Construction work is now in progress. The line will pass through a level timber country with light grades and curves. There will be no important bridges with the exception of the one over the Great Northern tracks near Bemidji and a trestle about 800 ft. long over Lake Irving, near the same place. C. A. Smith, Minneapolis, Minn., is President, and M. D. Stoner, Bemidji, Minn., is Chief Engineer.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—It is reported that this company has given a contract for building an extension of the Washburn & Great Falls recently bought by this company, from Washburn, N. Dak., toward the northwest along the east side of the Missouri river, 24 miles.

MISSISSIPPI, LOUISIANA & TEXAS.—See Railroad Corporation News.

NEW ORLEANS GREAT NORTHERN.—See Railroad Corporation News.

OCILLA, PINEBLOOM & VALDOSTA RAILROAD.—A charter has been granted in Georgia to a company under this name with a capital of $200,000. Construction work will be commenced at the terminus of the Douglas, Augusta & Gulf (formerly the Wadley & Mt. Vernon Extension) at the Satilla river, running through Willacoochee and Pinebloom, in Coffee County, and thence through Nashville to Adel, in Berrien County, about 40 miles. The principal office of the company will be at Pinebloom. B. B. Gray and others, of Coffee County, are incorporators.

OKLAHOMA & CHEROKEE CENTRAL.—Surveys are reported completed by this road for its proposed line from Pryor Creek, via Chelsea, Nowata and Alluwee, to Bartlesville, Ind. T., about 60 miles, and the contracts will at once be let, and grading started this month. G. M. Green and C. R. Havighorst, of Guthrie, Okla. T., are interested.

OKLAHOMA & TEXAS.—This company, which was recently incorporated with a capital of $5,000,000, is planning to build a line from Oklahoma City to a point on the Fort Worth & Denver City, in either Clay or Wichita County, Texas, about 200 miles. The proposed road will be an air line from Oklahoma City to either Wichita Falls or Henrietta, Texas, and will cover practically the old line surveyed by C. G. Jones, of Wichita Falls, but later abandoned. Bridges will be built over the South Canadian river near Tuttle, Ind. T.; over the Washita river near Lindsay, Ind. T., and over the Red river north of Henrietta. Surveys are reported about completed and contracts will soon be let.

OWEN SOUND & MEAFORD.—The Dominion Parliament has been petitioned by a com-

pany under this name for permission to build a road from Owen Sound to Meaford, 20 miles. Mackay, Sampson & Telford, solicitors, are acting for the promoters.

PENNSYLVANIA LINES WEST.—About nine miles of additional second track will be laid on the Indianapolis division of this road between Woodstock and Hagenbaugh. The work includes some grading and bridge construction, and will cost about $325,000.

On the Pittsburg, Cincinnati, Chicago & St. Louis improvements in the Pittsburg district, which represent expenditures upward of $2,500,000 have recently been completed. The new yards at Scully and the cut-off which will connect the Fort Wayne with the P., C., C. & St. L., will at once be put into service, adding materially to the terminal facilities. The work included a new yard that will accommodate over 2,000 cars; also the construction of a new line some fifteen miles long. The cut-off is formed by linking the Ohio connecting railway with the Duff branch, the latter being connected with the Chartiers branch through the construction of a new piece of road, giving a direct line from a point on the Fort Wayne main line to Sheridan, on the main line of the P., C., C. & St. L. All through freight from points on the Fort Wayne destined to points on the P., C., C. & St. L., and vice versa, will be handled by way of the new connecting link.

PORT ARTHUR & HOUSTON SHORT LINE.—Surveys, it is reported, are being made by this company for the proposed line from Port Arthur, Tex., to Houston, Tex., about 85 miles. This is supposed to be a project of the International & Great Northern. J. P. Ward, of St. Louis, is Vice-President, and C. S. Cleveland, of New York, Chief of Construction.

RIO GRANDE, SIERRA MADRE & PACIFIC.—This company has been incorporated in Mexico, with a capital of $3,000,000, by W. C. Greene, and will have its headquarters at Mexico City.

ROCHESTER & EASTERN ELECTRIC.—It is reported that this electric road, from Geneva, N. Y., to Rochester, and the electric road running east from Geneva to Waterloo and Seneca Falls, have been sold to a syndicate represented by O. N. Crane. It is the intention of the new owners to double-track both roads and extend the Seneca Falls line east to Auburn, connecting at that place with the line to Syracuse. A line is also projected to be built from Buffalo to Rochester.

ST. LOUIS & SAN FRANCISCO.—This company, it is reported, has given a contract to the Dalhoff Construction Co., of Little Rock, Ark., to build a line from Traskwood, Ark., to Crossett, 107 miles, passing through parts of Saline, Grant, Dallas, Calhoun, Bradley and Ashley counties. A branch line will also be built to Eldorado from a point along the line in Calhoun or Bradley counties.

SOUTH & WESTERN.—This company, which failed in the courts to sustain an old charter, has obtained a new one and is now securing rights of way for a line to be built from Clinchport, Scott County, Va., to Gate City, 15 miles. The proposed line will parallel the Virginia & Southwestern between those points. Geo. L. Carter is President.

SOUTH DAKOTA CENTRAL.—Surveys are reported being made for an extension of this road from the present terminus at Colton, S. Dak., to Madison, 15 miles. P. F. Sherman, Sioux Falls, S. Dak., is President.

TORONTO & HAMILTON.—Bids are wanted by Frederick Nicholls, President, May 1, at Toronto, Ont., for the grading, culverts, masonry bridges and other work between Toronto and Niagara Falls on the line of its road. Plans and profiles may be obtained at the company's engineering department, Pacific Building, Toronto.

WABASH.—Announcement has been made that this company has decided to begin at once double-tracking the Pittsburg branch. Work will be started at several points between Pittsburg and Pittsburg Junction, 40 miles.

WESTERN OHIO.—Location stakes have been set by this company between Lima and Findlay, Ohio, 30 miles, and construction work will be commenced at once near Rawson, and also between Bluffton and Findlay.

WESTERN, OHIO (ELECTRIC).—A contract, it is reported, has been given by this company to the Cleveland Construction Co., for building the extension from Lima to Findlay, 35 miles.

RAILROAD CORPORATION NEWS.

ATCHISON, TOPEKA & SANTA FE.—Fisk & Robinson, of New York, are offering at 96 and interest a block of the 4 per cent. adjustment gold bonds of 1995 of this company. The lien of these bonds follows and is coextensive with that of the general mortgage 4 per cents, embracing over 8,000 miles of line, with all equipment and terminals. The rate of 4 per cent. payable out of income and cumulative since 1900, has been maintained since 1898. The present issue, which is limited to $51,728,000, and of which $51,346,000 is outstanding, may be increased by $20,000,000 in amounts of $2,000,000 each year after July 1, 1905.

ATLANTIC SHORE LINE (ELECTRIC).—This company, which began business on April 1, 1904, and which operates 35.39 miles of line about Sanford, Me., has paid a dividend of 2½ per cent. on its preferred stock, covering the period from October 1, 1904, to March 1. The only previous dividend was one of 3 per cent. for the first six months of operation. No dividends have been paid on the common stock.

CANADIAN NORTHERN.—The Canadian Bank of Commerce has recently offered in London at 95, the entire issue of $9,300,000, 3 per cent., first mortgage, debenture stock of this company, running for 50 years, from July 10, 1903, guaranteed principal and interest by the Dominion Government. This issue is described as being a first mortgage charge (1) on the main line from Grand View, Man., via Battleford, Saskatchewan to Edmonton, Alberta, 620 miles, through the great wheat belt of northeastern Assiniboia, Saskatchewan and northern Alberta; and (2) the branch line from Dauphin, Man., northwest via Swan river and Carrot river valleys, to Prince Albert, 100 miles. It is also a charge next after existing charges on other lines in operation. Construction work is reported to be rapidly progressing, and it is expected that the lines to Edmonton and Prince Albert will be in operation in time for this year's wheat crop. With the completion of the lines above mentioned, and several branches in Manitoba, the total mileage of the company's lines will be approximately 2,788 miles.

COLUMBUS, NEWARK & ZANESVILLE (ELECTRIC).—Baker, Ayling & Co., of Boston, are offering at 98 and interest, $400,000 first mortgage 5 per cent. bonds of 1924, of this company, which owns the local street railroads in Newark, Ohio, a suburban line to Granville, and an interurban line from Newark to Zanesville, a total of 42 miles. From Zanesville cars of this company run over an affiliated line to Columbus. The entire issue of these bonds (but no part thereof) may be redeemed at 110 and interest. The mortgage is limited to $2,000,000, of which $1,250,000 is outstanding. The remaining $850,000 outstanding has been bought by the Electrical Securities Co., of New York, and the Union Electrical Securities Co., and the Railways & Securities Co., of Boston. Of the authorized issue, $750,000 is reserved for extensions.

CONSOLIDATED RAILWAY (NEW YORK, NEW HAVEN & HARTFORD).—Lee, Higginson & Co., of Boston, have made an offer of $225 a share for a majority or all of the stock of the Springfield Street Railway. Stockholders may receive payment in cash, or $75 in cash and $140 in 4 per cent. cumulative preferred stock of a holding company to be called the Springfield Railways Co. This preferred stock to the amount of $3,000,000 will be a first lien on $4,500,000 Springfield Street Ry. stock, and furthermore is guaranteed unconditionally by the Consolidated Railway. It is callable at 105 and non-taxable in Massachusetts.

DELAWARE, LACKAWANNA & WESTERN.—The directors of this company have declared a quarterly dividend of 2½ per cent. on the stock, payable April 20. This is at the rate of 10 per cent. annually, an increase of 3 per cent. over the 7 per cent. which has been paid annually since 1886. An extra 10 per cent. dividend was declared last December. The stock has recently sold at 400; higher than ever before.

DENVER & RIO GRANDE.—This company's statement for the month of February shows a decrease in total net earnings from $428,380 in 1904, to $407,431 in 1905. Gross earnings for the eight months' period from June 30 were $11,421,747 in 1905, against $11,290,083 in 1904. Operating expenses were $6,941,033 in 1904, and in 1905 $6,725,127. This leaves net earnings, plus other income, of $4,866,679 in 1905, against $4,550,787 in 1904, an increase of $315,892 The surplus is $2,027,372 in 1905, and $1,803,003 in 1904, less a dividend of 2½ per cent. in each case. This leaves a remaining surplus of $917,372 in 1905, and $693,003 in 1904.

GRAND TRUNK PACIFIC.—N. M. Rothschild & Sons have offered in London, England, at 95, $15,600,600 first mortgage bonds of this company, guaranteed by the Canadian Government.

LANCASTER, OXFORD & SOUTHERN.—This company, which operates a narrow gage line from Oxford, Pa., to Susquehanna, 20 miles, has given a mortgage for $200,000 to the Farmers Trust Co. The mortgage covers the entire line, as well as projected branch from Fairmount to Quarryville. The road, it is understood, will be changed into a trolley line.

LEHIGH COAL & NAVIGATION.—The annual report of this company for 1904 shows a total revenue of $3,090,766, less a loss on canals of $159,457. The total disbursements were $1,363,434, which leaves net earnings of $1,567,875, less a sinking fund of five cents per ton on 2,045,545 tons of coal, or $102,277, which gives net revenue of $1,465,598. Dividends of $1,104,051 were paid, leaving a balance to the credit of profit and loss of $361,546. The revenue was derived from the following sources: From the Lehigh & Susquehanna Railroad, which runs from Union Junction, Pa., to Phillipsburg, N. J., 105 miles, with 59 miles of branches, and is leased to the Central Railroad of New Jersey at a rental of one-third of the gross receipts, $2,192,058; from other railroads, $73,969; from Lehigh coal lands, $601,418, and from miscellaneous receipts, $223,322. The coal tonnage of the Lehigh & Susquehanna and the Lehigh Canal was: In 1901, 6,937,060 tons; in 1902, the year of the strike, 3,946,170; in 1903, 7,651,823 tons. This largely increased tonnage in 1903 has nearly been maintained in 1904, when the total tonnage was 7,473,051 tons. The Lehigh Coal & Navigation Co. controls the Lehigh & Hudson River Railroad, which runs from Easton, Pa., northeast through Belvidere, N. J., Sussex and Warren Counties, N. J., and Greycourt, N. Y., to Maybrook, three miles from Campbell Hall, N. Y., on the Central New England branch of the New Haven road, 90 miles. During the year a controlling interest in the Lehigh & New England Railroad, a successor of the Pennsylvania, Poughkeepsie & Boston, which runs from Slatington, Pa., northeast through Sussex and Warren Counties, N. J., to Campbell Hall, 90 miles, was purchased. With this was merged by exchange of securities the Lehigh & Lackawanna, foreclosed during the year and reorganized as the Lehigh & Delaware, under which name it is operated from Bethlehem, Pa., through Wind Gap, to Saylorsburg and Bangor, 36 miles. By this consolidation, the Lehigh & New England has, with branches, a total of 175 miles of trackage. The capital stock of the Le-

high Coal & Navigation Co. was increased during the year by 31,455 shares, or $1,572,700, an amount equal to 10 per cent. of the stock outstanding, making the total amount of stock issued, including that owned by the company, $17,378,500.

Market Street Elevated (Philadelphia).—Drexel & Co., of Philadelphia, are offering at 101, $10,000,000 first mortgage 50-year 4 per cent. gold bonds of 1955, principal and interest guaranteed by the Philadelphia Rapid Transit Co.

Maryland & Pennsylvania.—Alexander Brown & Sons, of Baltimore, are offering at 93½ and interest, a portion of the first mortgage gold 4 per cent. bonds of this company, which are a first lien on 80 miles of road, subject to $202,450 underlying bonds. The authorized issue is $1,200,000, of which $897,000 is outstanding.

Michigan Central.—The old St. Joseph, South Bend & Southern, which runs from South Bend, Ind., to Benton Harbor, Mich., is to be turned over to the Michigan Central by the Indiana, Illinois & Iowa as a part of the unification of the Vanderbilt system. This will give the Michigan Central a direct line to St. Joseph and Benton Harbor. The new line will be a part of the Western Division.

Mississippi, Louisiana & Texas.—This company, which was incorporated about a year ago, with an authorized capital stock of $31,500,000, to build from the Gulf of Mexico, at or near Pensacola, Fla., via Mobile, Ala.; Natchez, Miss.; Freeport, La.; South McAlester, Ind. T., and Oklahoma City to Guthrie, Okla. T., is offering at par the unsold portion of $3,000,000 first mortgage 5 per cent. gold coupon notes, due March 15, 1910, and subject to call at 102. The notes provide that no incumbrances shall be placed upon the property in Alabama or in Florida until the notes shall have been paid in full.

Missouri Pacific.—Fisk & Robinson, of New York, are offering at 116¾ and interest a block of the general consolidated railroad and land grant mortgage gold 5 per cent. bonds of 1931, of the St. Louis, Iron Mountain & Southern. These are a direct first lien on 1,400 miles of road from St. Louis south to Alexandria, La., and Texarkana; also on equipment and other property, including lands in the state of Arkansas granted by Congress of which some 250,000 acres remain unsold; and also are secured through a deposit of capital stock of the par value of $2,209,375 of the Arkansas Midland, Arkansas Central and Brinkley, Helena & Indian Bay railroads, which are parts of the system. The total issue of these bonds is $43,713,000, of which $6,895,000 are guaranteed principal and interest by the Missouri Pacific.

The control of the St. Louis, Watkins & Gulf, which runs from Alexandria, La., southwest to Lake Charles, 98 miles, with three miles of branches, has been acquired by the St. Louis, Iron Mountain & Southern, which owns $499,380 of the authorized capital stock of $1,225,000, of which about $993,360 is outstanding, and $527,260 of the authorized issue of $1,225,000 first mortgage bonds of which $983,360 is outstanding.

New Orleans Great Northern.—This company has sold $5,000,000 of an authorized issue of $10,000,000 first mortgage 5 per cent. 50-year gold bonds to a syndicate headed by Fisk & Robinson, of New York. These bonds are to be issued at a rate not exceeding $30,000 per mile, including $5,000 per mile for rolling stock. Additional mortgage bonds to the extent of $2,500,000 may be issued for the acquisition of terminals, to the extent of $1,500,000 for additional equipment, and to the extent of $1,000,000 for bridges or car ferries. The bonds will be a lien upon the entire property of the company, including terminals or terminal rights in the city of New Orleans. According to a letter of President F. H. Goodyear, of Buffalo, the company will acquire the railroad owned by the East Louisiana, extending from a junction with the New Orleans & Northwestern at Pearl River Junction, via Abita Springs and Covington to Folsom, with a branch to Mandeville, on Lake Ponchartrain, a total of 48 miles. The company at present runs trains into New Orleans over the tracks of the New Orleans & North-Eastern, but intends to acquire its own terminal property. It also plans to relocate the East Louisiana line, relay it with 80-lb. rails and extend it northerly to Jackson, Miss., 150 miles, where connection can be made with the Illinois Central, Yazoo & Mississippi Valley and Alabama & Vicksburg. This projected line would have easy grades and curves. A contract has been made with the Great Southern Lumber Co., which owns 325,000 acres of long leaf yellow pine timber lands extending north 100 miles from Lake Ponchartrain, and has a paid-up capital of $5,000,000, with no indebtedness. The Lumber Company will build lumber mills having a capacity of 75,000,000 ft. yearly, and will ship all of its products over the road.

New York Central & Hudson River.—The *Commercial and Financial Chronicle* reports the terms of the contract recently entered into by the New York Central through the Utica & Mohawk Valley (Electric) with the Hudson River Water Power Co., of Glens Falls, N. Y., to supply power for its electric lines for 25 years from July 1. The sub-stations and transmission lines now in use by the trolley company are turned over without charge to the water power company. The Utica & Mohawk Valley is to take at first 4,500 h.p., increasing as requirements demand up to 20,000 h.p. During the term of the contract, or before it has made use of the entire 20,000 h.p., the railroad company may not contract for or obtain power from any other source, or make it by steam for its own use. The railroad company is to pay a flat rate equal to two-thirds of its maximum demand whether the power is used or not. The price paid is considerably in excess of $50 per h.p. per year for 24 hours' use daily.

See review of annual report in editorial pages.

Old Colony Street Railway.—Hayden, Stone & Company, of Boston, are offering at 96 and interest the unsold balance of $1,000,000 first refunding mortgage 4 per cent. gold bonds of this company due in 1954. The Old Colony Street Railway is a consolidation of all the lines of the Massachusetts Electric Companies south of Boston as far as Newport and New Bedford, and operates 367 miles of track. Four million six hundred and sixty-seven thousand dollars of these bonds are reserved to retire an equal amount of prior lien bonds, of which $2,516,000 mature by 1916 and all mature before 1925, when the refunding bonds become an absolute first mortgage on all property they do not already cover as a first lien. These bonds are not only an absolute first mortgage on the new power station at Quincy, but also on the Quincy & Adams Street Ry. Co., which operate 41¼ miles of track. The authorized issue is $10,000,000. The present issue is part of the $1,777,000 outstanding. The three-year coupon notes of the Massachusetts Electric Co.'s, due January, 1906, will be taken in exchange.

Panama Railroad.—William Nelson Cromwell, General Counsel of this company, has bought for the United States Government 270 of the 275 shares of Panama Railroad capital stock that were outstanding, and has a contract for the delivery of the remaining five shares.

St. Louis, Brownsville & Mexico.—The $1,063,000 first mortgage bonds recently issued by this company on its line from Brownsville, at the southern extremity of Texas north to Robstown, 141.75 miles, were part of an authorized issue of $4,000,000 5 per cent. gold bonds of 1910. These bonds are subject to call at par on any interest day, on 60 days' notice. It is reported that further bonds are to be issued on the Fordyce branch, which is in operation from Harlingen west to Fordyce, 55.7 miles, and on the line from Robstown to Bay City, 142 miles, now building.

Spokane International.—This company, whose projected line is to run from Spokane, Wash., to a point on the Crows Nest Pass branch of the Canadian Pacific, about 140 miles, is reported to have made a 50-year traffic agreement with the Canadian Pacific which gives that company an entrance into Spokane, and to have sold $4,000,000 bonds.

Temiskaming & Northern Ontario.—The Government of the Province of Ontario is reported to have decided upon an issue of $6,000,000 bonds to refund the loan which falls due May 1, obtained for building this road.

Union Pacific.—A special meeting of the stockholders of the company has been called for May 5 for the purpose of increasing the preferred stock by the amount of $100,000,000. An amendment to the articles of incorporation authorizing the increase and also authorizing the issue of new bonds of the company will be submitted to the stockholders. President E. H. Harriman, in a circular to the stockholders, says: "Of the $100,000,000 first lien convertible bonds originally issued by the company, $54,255,000 have been converted up to date into common stock, and it is assumed that the remainder will likewise be converted before May, 1905. Fixed charges have thereby been greatly diminished, and the equity behind the preferred stock correspondingly increased, and, with the enhanced credit of the company, the market value of the preferred stock is, and for some months has been, about par. This situation enables the company to pursue the wise and conservative policy which requires that a corporation, whenever possible, should finance at least a part of its capital requirements, especially such as arise in connection with the acquisition of stocks of other companies, through the issue of stock, rather than through the creation of fixed interest bearing obligations.

Vandalia.—An issue of $7,000,000 of the authorized issue of $25,000,000 consolidated mortgage 4 per cent. gold bonds of 1955 has been purchased by Speyer & Co., of New York. These bonds are a first lien on the railroad from East St. Louis across Illinois to the Indiana state line, 180 miles, and from Logansport, Ind., to Butler, 93 miles; as well as a lien subject only to $4,700,000 underlying bonds for which an equal amount of consolidated bonds is reserved on the remaining 358 miles of line owned. Of the present issue of $7,000 000 the sum of $5,927,000 will be used to take up matured underlying bonds, and the remaining $1,073,000 for new construction and for equipment.

Wabash.—Wm. A. Read & Co. and Geo. P. Butler & Bro., of New York, are offering jointly at 98¾ and accrued interest $10,000,000 five-year 4½ per cent. notes of this company dated May 1, 1905. These notes are part of an authorized issue of $17,000,000, the remaining $7,000,000 being reserved for future requirements. The notes are secured by a mortgage, subject to existing lines, on all the lines of the Wabash Railroad Company east of Chicago not covered by the debenture mortgage, including the main line between Chicago and Toledo, and the line between New Haven, Ind., and Butler; also the leasehold interest in the Grand Trunk lines between Detroit and Buffalo. They are also secured by the deposit as collateral of all bonds to be issued under an authorized issue of $15,000,000 new general mortgage five-year 5 per cent. gold bonds of the Wheeling & Lake Erie junior to existing mortgages, and by the deposit of the notes of the Wabash-Pittsburg Terminal already issued. The proceeds from the sale of the new Wabash notes will be used to meet the demands of increased traffic brought to the Wabash lines by the Pittsburg connection.